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DIVERSIFICATION AND PROFITABILITY AMONG LARGE FOOD PROCESSING FIRMS

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PREFACE

Farmers and numerous legislative and economic groups concerned with agricultural policy have become increasingly aware of the conglomerate acquisitions and internal growth affecting food industries. In recent years, firms in food processing have, through internal and external growth, enlarged their product lines to include more food products and numerous nonfood products from other manufacturing industries. Farmers and consumers have wondered what such changes mean for the firms with which they conduct business and what effect these changes will have on their market relationships with these firms.

The specific objectives of this study are to determine: (1) whether any observable relationships existed between the degree of diversification of food processing firms and their performance variables, such as profit rates and margins; (2) the relationship of other structural variables, such as concentration and size of firm, to profit variables; (3) effects of the degree of diversification on the stability of profit rates of food processing firms over time; and (4) the measurement problems associated with product diversification.

Information about these objectives should contribute to the insights and attitudes of farmers, consumers, and legislative and economic groups as these groups struggle to form policies appropriate for today's food markets.

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WASHINGTON, D.C. JANUARY 1970

SUMMARY

No statistically significant positive (linear or quadratic) relationship was found to exist between variables—concentration, diversification, size, and certain capital requirements—and differences in the levels of profitability. These levels were measured by the return on invested capital, that is, the ratio of net profit after taxes to net worth. The variables represented characteristics of the large food processing firms and the industries to which these firms belong. Relationships had been found to exist between similar structural measures (variables) and profitability in at least two other studies covering large firms in numerous manufacturing industries (23 and 54).* But such relationships were not found among the firms in the present study.

The largest firms in the sample are not necessarily the most profitable. The size distribution of firms in the food processing sector of the economy suggests that, typically, the next to the largest group of firms in this sector are the higher profit firms. This does not mean that there are no exceptions. In the subsample of 44 firms included in appendix A, only a very weak relationship was found between profitability and size.

Diversified firms are not found to be more profitable than nondiversified or less diversified firms. However, lack of such evidence does not preclude the possibility that diversification might increase the profitability of a firm over time.

A 20-year time series of profit rates was developed for a random sample that consisted of one-third of the firms used in study tests. These firms were placed in four groups by an ordinal ranking of degree of diversification. No significant differences were found in the average profits among the four groups over time, although there could have been differences among firms within groups. Only slight differences in profit growth were present during the period, and the averages were not different at the 95-percent confidence level. However, the profit variability for group 4, the highly diversified firms, is significantly less than the profit variability for group 1, the nondiversified firms. In fact, the order of variability of profits among the groups, ranked from lowest variance to highest, is 4-2-3-1.

Clearly, the positive correlation between the variables mentioned above and average gross margin is higher than that between the same variables and net profit rate. Absolute size of firm was positively correlated (with statistical significance at the 95-percent confidence level) with the levels of average gross margin. Differences in primary industry concentration or weighted concentrations remain as weak, explanatory factors in differences in profitability.

It may not be newsworthy to report results that, at best, explain only 20 percent of the differences in profitability among firms studied, with some exceptions. We know that certain other economic and noneconomic factors, such as strikes, wars, changes in input costs, weather, and so forth, can affect profits. Even so, we must not take lightly the fact that only 20 percent of the differences in profit rates among these firms were associated with differences in the structural conditions (as measured in this study).

These results are consistent with Bain's position that industry concentration, in and of itself, should have little influence on profit rates except at extreme levels of concentration (4, pp. 312-313). Such consistency is not surprising. Economic theory indicates that market outcomes (performance) in monopolistically competitive and oligopolistic industries depend not only on structural conditions but also on rigid behavioral conditions (conduct). Structure, particularly within the realm of oligopoly cases, does not dictate conduct. It increases the number of feasible modes of conduct. This point alone constrains one's ability to draw further conclusions from this research as do any of the other weaknesses listed in the study.

Through weaknesses exist and many questions remain unanswered, this study nonetheless provides significant empirical information about large food processing firms. As future studies examine the unanswered questions, we can fill in gaps in our basic understanding of the effect of large food processing firms on the national economy. We can then increase the accuracy and amount of both empirical and theoretical knowledge about market performance.

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*Numbers in parentheses refer to items in Literature Cited.

DIVERSIFICATION AND PROFITABILITY AMONG LARGE FOOD PROCESSING FIRMS

By
Richard J. Arnould [1]

INTRODUCTION

This study is an attempt to determine the extent to which differences in profit rates of a sample of large food processing firms can be explained by differing market structures, size of firms, and degrees of diversification. The firms in the sample were publicly held corporations listed in either Moody's Industrial Manual or The Fortune Plant and Product Directory. Variables were constructed in a manner that permitted testing of hypotheses by use of least squares regression.

The firm is used as the unit of measure for the following reasons: (1) Certain structural conditions that have changed in recent years, such as size and product diversification, relate to individual firms and not just the industry (or industries) within which the firm produces goods, and (2) use of the firm as a unit allows for direct separation of large from smaller firms in an industry of a given structure, direct comparison of large with smaller firms in such an industry, and direct comparison of industries of varying structures.

Identification of relationships between structural measures and profit rates is important to provide evidence to fill the void existing beyond the mere tabulation of numerous structural data. The intent is to link structural measures to performance characteristics. This task is not easily accomplished. Performance characteristics are difficult to identify in a quantifiable manner. Thus, the researcher must rely on proxy measures. Concepts of competition and efficiency relate to firms operating in well-defined markets. The identification of these markets is a difficult task and often must be guided and constrained by data availability. Theory specifies that various levels of performance result from certain market structures with well-specified behavioral conditions or modes of conduct. Contemporary authors assume these modes of conduct exist if predefined market structural conditions exist. Such conditions permit writers to hypothesize relationships between structure and performance. Loss of the direct incorporation of behavioral assumptions in the model opens a major gap between hypothesized theory and empirical validation of the hypotheses. Finally, the lack of a consistent and complete set of data often requires the use of vague identification concepts.

These problems are manageable if one is willing to sacrifice generality, which seems to be a necessary first step in filling the void mentioned earlier. Loss of generality, though undesirable, permits development of numerous specialized hypotheses, which, when tested, yield evidence in support of the more general question: What is the relationship between structure and performance?

This study represents such a specialized effort. It attempts to fill the gap between hypothesized theory and empirical validation by relating structural characteristics to profit rates of food manufacturing firms. However, the degree of generalization possible from results of the study is constrained by the sample of firms studied and the data available to test hypotheses. The sample is diverse enough, in both size of firm and location of industry, to represent the large food processing firms. Such a sample should yield results concerning the extent of competition and the efficiency level in the food processing sector as these performance measures are represented in the study.

[1] Assistant Professor of Economics, University of Illinois at Urbana. The research for this study was conducted while the author was an Agricultural Economist with the Economic Research Service, USDA.

The extent to which this effort could be realized and the desired results obtained was further handicapped by additional limitations that warrant direct mention.

Structure and performance are multidimensional concepts. Thus, only certain aspects of structure and performance have been considered here and in previous research. Other aspects, such as the influence of vertical structural relationships (not necessarily vertical integration), have been ignored.

The problem of multidimensionality of structure was increased by the difficulty of quantifying the few structural dimensions chosen. The best available measures are still proxies of the truly desired concept and had to be evaluated in this light. The proxy measures used are dictated by data availabilities, in most instances.

The general concept of diversification is clear to everyone. The concept becomes nebulous when an attempt is made to specify (in terms of product markets) what characteristic differences in products are needed to enable some combinations of products to be called diversification and others to be called horizontal or vertical combinations. Here, "combination" does not necessarily imply merger. Thus, one hopes for consistency—although not necessarily uniqueness—in choosing an appropriate definition of diversification. More needs to be done to test the sensitivity of the diversification indices of this study, as well as other possible indices, to different classification schemes.

Any attempt to measure the structure of firms and industries is constrained by our inability to delineate product and geographic markets and industries. Economists have long used the terms industry and market distinctively, but the difference made of this distinction is only a surface distinction. Industry usually refers to a group of economic units that have similar production functions, that is, transforming inputs into similar outputs, using similar techniques. A market contains not only the units that supply the goods but also the units that demand the goods. There is no reason to assume that such a market should contain only the goods produced in one industry that fits the above definition. Thus, market competition might differ from industry competition.

Another limitation was that measurement problems were accentuated by data problems. This study has relied quite heavily upon the Standard Industrial Classification (SIC), with only minor adjustments made because of the available data. Some adjustments made by other researchers were valid and helpful. However, adjustments usually require data averaging to restore numbers for the new and old categories, which may, in many cases, produce as much error as the original partial misclassification.

Geographic market adjustments have been quite poor, except in specific cases, particularly when State concentration ratios were used as the adjustment factor. These ratios were weak, particularly in States that had large population centers on or near a border.

Profit rates, as well as other accounting measures, are susceptible to measurement inconsistencies when different accounting procedures are used. Whenever possible, these inconsistencies were corrected for use in this study. Other problems are mentioned throughout the report.

STRUCTURAL INDICATORS FOR THE FOOD PROCESSING SECTOR

Before introducing general indicators of structure in food processing industries, it is worthwhile to review the purposes of studying structural conditions of markets. A market consists of a directly related group of buyers and sellers of closely related products or services. The structure or organization of the market accounts for the number and size distribution of buyers and sellers in a market. The number and size distribution of buyers and sellers is referred to as buyer concentration and seller concentration.[2] Attention in this study was directed toward seller concentration.

Structural information in earlier reports was studied to determine and predict the performance of markets. Earlier studies dealt primarily with the determination of geographic markets, channels of distribution, and other "physical market characteristics" (9,p.1). These studies were descriptive and seldom yielded or were intended to yield performance predictions.

More recent studies have attempted to determine the deviation from desirable performance that exists when an industry deviates from atomistic structure. The compelling concept is that a firm in an atomistically structured industry lacks individual pricing power and is thus forced to maintain high levels of efficiency by the "competitive market mechanism" (11). The competitive market mechanism, in turn, requires that efficiency or gains in efficiency be reflected in the buyer's price. In this sense, structural conditions are used to describe market conditions that will yield acceptable market performance.

The task of the present study is to determine whether relationships exist between structural characteristics of large food processors and the profit levels they have achieved. This is accomplished first by reviewing general structural patterns in the food manufacturing industries and second, by presenting a regression model to aid in the identification of possible relationships between structural components and profitability.

STRUCTURAL PATTERNS IN FOOD MANUFACTURING INDUSTRIES

In 1963, over 1.5 million people were employed in the food manufacturing industries. The value added in food manufacturing exceeded $21 billion. Value added is more than 2.5 times larger than for the same industries in 1947 (35). During this period, almost 20 percent of personal consumption expenditures were for food products.

More than 31,000 companies were primarily engaged in food processing in 1963, compared with 8,800 in chemicals and allied products and 6,200 in primary metals. Food manufacturing corporations accounted for 21 percent of the total advertising of all manufacturing corporations in 1962 (38, p. 66). Dollar sales of corporations in this sector grew by more than 76 percent from 1947 to 1962, while the dollar sales of unincorporated firms in the same sector grew by 4.9 percent (23, p. 8).

A more vivid characterization of the changes taking place in the structure of the food sector can be seen in the following comparison of the economy. The size of the food processing sector (SIC 20) is represented by a value added of $21,826 million, 1.7 million employees, and 38,587 establishments in 1963 (35, Part II). This size is compared with a total value added of $17,586 million in the chemicals and allied products sector (SIC 28), and $15,261 in the primary metals sector (SIC 35). A comparison of three major sectors between 1947 and 1963 is given in table 1. The food sector increased in value added by 139 percent, compared with 231 percent for the chemicals sector and 166 percent for the primary metals sector.

The only obvious differences in the 1947-63 changes in these sectors are the 10 percent decline in the number of food manufacturing establishments, compared with increases of 26 percent in the number of establishments in the chemicals and primary metals sectors; and the similar decline of 12 percent in the number of food processing companies, compared with increases of 4 and 32 percent in chemical and primary metal producing companies.

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[2]Various specific measures of these concepts are discussed later in the report.

Table 1.—Growth of major sectors of the economy, 1947-63

Sector	1947	1963	Percentage change
Food and kindred products:			
Value added (000)[1]	9,115,975	21,825,516	139
New capital expenditure (000)	820,847	1,249,245	52
Employment	1,461,364	1,714,607	17
Establishments	42,802	38,587	-10
Companies[2]	36,122	31,713	-12
Chemicals and allied products:			
Value added (000)	5,317,001	17,586,000	231
New capital expenditure (000)	804,958	1,545,689	92
Employment	626,418	853,121	36
Establishments	10,019	12,575	26
Companies[2]	8,461	8,794	4
Primary metals:			
Value added (000)	5,733,028	15,261,087	166
New capital expenditure (000)	592,177	1,446,303	144
Employment	1,158,158	1,166,953	8
Establishments	5,365	6,739	26
Companies[2]	4,715	6,237	32

[1] (000) signifies figures opposite are monetary. Figures without (000) opposite are not monetary but numerical.

[2] Company data are for 1954, since 1947 totals were not published by the Bureau of Census.

Source: Bureau of the Census (35).

The 12-percent decline in the total number of companies in food processing has drawn significant attention to the study of competition in this sector. The reduction in the number of companies has been taken by some to mean a reduction in the amount of competition and an increase in the extent of oligopolistic and monopolistic performance. The data also reveal that an increase rather than a decrease has occurred in the number of large companies (assets in excess of $50 million). More, rather than fewer, larger companies now are competing. The assets of companies leaving food industries continue to be purchased by a number of the larger companies rather than by the few largest. Such purchasing has led to the increase, noted above, in the number of larger firms. It has also led to the difficult task of pinpointing true changes in the number and, more particularly, size distribution of firms in this sector. In 1947, only 31 food processing companies had assets of $50 million or more. In 1962, 68 corporations were in the same category, an increase of more than 100 percent (38). To indicate further this structural phenomenon, over the 1954-63 period, the 20 largest food processing companies increased their share of value added originating in food processing from 22.1 to 22.8 percent. The 200 largest food processing corporations displayed an increase in their share of value added of 5.8 percentage points (from 48.7 to 53.5) (23 and appendix A). Thus, the most significant change was not among the 20 largest firms.

The difficulty discussed of determining real changes in size distribution of firms was also displayed by the changes in concentration in the four-digit food industries. The following tabulation presents 40 four-digit industries in the Standard Industrial Classification for Major Industry Group 20, the food and kindred products sector:

SIC code	Industry identification
201	Meat products
2011	Meat packing (slaughtering) plants
2013	Sausage and other prepared meat products (not made in slaughtering plants)
2015	Poultry and small game dressing and packing, wholesale
202	Dairy products
2021	Butter and related products
2022	Cheese, natural and processed
2023	Concentrated milk
2024	Ice cream and frozen desserts
2026	Fluid milk
203	Canning, preserving, and freezing
2031	Canned and cured seafoods
2032	Canned specialties
2033	Canned fruits and vegetables, preserves, jams, and jellies
2034	Dried and dehydrated food products
2035	Pickled fruits and vegetables, vegetable sauces and seasonings, and salad dressings
2036	Fresh and frozen packaged fish
2037	Frozen fruits, fruit juices, vegetables, and specialties
204	Grain mill products
2041	Flour and other grain mill products
2042	Prepared feeds for animals and fowls
2043	Cereal preparations
2044	Rice milling
2045	Blended and prepared flour (made from flour not milled in same establishment)
2046	Wet corn milling
205	Bakery products
2051	Bread and other bakery products, excluding biscuits, crackers, and pretzels
2052	Biscuits, crackers, and pretzels
206	Sugar
2061	Cane sugar, except refining only
2062	Cane sugar refining
2063	Beet sugar
207	Confectionery and related products
2071	Candy and other confectionery products
2072	Chocolate and cocoa products
2073	Chewing gum
208	Beverages (excluding alcoholic beverages)
2086	Bottled and canned soft drinks and carbonated waters
2087	Flavoring extracts and flavoring syrups
209	Miscellaneous food preparations and kindred products
2091	Cottonseed oil mills
2092	Soybean oil mills
2093	Vegetable oil mills, except cottonseed and soybean
2094	Animal and marine fats and oils
2095	Roasted and concentrated coffee
2096	Shortening, table oils, margarine, and other edible fats and oils
2097	Manufactured ice
2098	Macaroni, spaghetti, vermicelli, and noodles
2099	Food preparations not elsewhere classified

Of these 40 four-digit industries, 22 are considered comparable for the purpose of calculating concentration ratios for the 1954-63 interval[3] Table 2 presents a picture of the changes in concentration for various intervals of firms in the industry size distribution of these 22 food processing industries (excluding alcoholic beverages). The percentage of value of shipments accounted for by the four largest firms declined in eight industries from 1954 to 1963, remained the same in one case, and increased in 13 cases. The share of value added of the 22 food industries, represented by the eight industries that had a decline in four-firm concentration, was 30 percent. The average decline was 5.6 percentage points per industry. The average increase for the 13 industries exhibiting such a move was 3.7 points per industry.

The percentage of value of shipments accounted for by companies ranked 5-8 in their respective industries increased in 14 cases and decreased in six. The 50 largest companies in these same four-digit food processing industries (which represent over 60 percent of value added in food processing, excluding alcoholic beverages) increased their share of value of shipments in 10 industries, witnessed no change in eight industries, and reflected decline in four industries.

Table 2–Changes in the concentration ratios of 22 four-digit food processing industries, 1954-63

Percentage points change in concentration ratio	Rank in size of firms within their industries			
	1-4	5-8	9-20	21-50[1]
	Number			
Decrease	8	6	6	8
No change	1	2	5	7
Increase 1-3	8	11	7	4
Increase 4-5	2	3	3	2
Increase 6-7	3		1	1
Total	22	22	22	22

[1] Data are available for 1958 and 1963 only.

Source: U.S. Senate Subcommittee on Antitrust and Monopoly (37).

These concentration ratios present more inconclusive evidence concerning the changing structure of the food processing industries. Over the 9-year period described above, increases in four-firm concentration ratios averaged less than one-half of one percentage point per year. The 50 largest companies witnessed no change or slightly increased their share of output in 18 industries. These changes were occurring simultaneously with a decline of at least 12 percent in the number of companies primarily engaged in food processing. The changes in concentration ratios indicate that either the firms leaving the industry account for a very small share of the market or the firms disappearing through mergers and abandonments are being picked up by existing companies of a variety of sizes. For food industries, much of the internal and merger growth of firms has been distributed among a large number of firms—not just the largest firm or firms in any given industry. This evidence, along with the evidence presented below, indicates that more than an examination of historical trends in concentration is necessary to determine the competitive aspects of food processing industries.

[3]The Census Bureau considers industries sufficiently comparable to show historical data" . . . if the employment in the plants reclassified into the new SIC to other industries, accounted for two percent, or less of the original total employment in the old SIC industry" (37, p. 5). The source for the tabulation is the Bureau of the Census, Numerical List of Manufactured Products, 1963 Census of Manufacturers.

Product Diversification

One facet of structure that does not appear in the data above is the extent of product diversification within firms producing food products. Twenty-eight of the 200 largest companies manufacturing food products are primarily engaged in nonfood manufacturing (including some service industries) (23, p. 238). The 200 largest food manufacturers had 28,027 establishments in 1963. Of these, 3,585 were classified in food manufacturing, and approximately 800 were other manufacturing establishments. The remaining establishments fell into what could be called, for the most part, vertical integration (23, p. 239).

The 100 largest food manufacturers[4] held, on the average, 7.3 leading positions[5] in either food or nonfood manufacturing classes in 1963. (The percent of possible leading positions against which to evaluate this average was not available.) The 100 largest companies occupied 78 percent of the leading four positions in four-digit food industries[6] The same companies occupied 70 percent of the leading four positions of the five-digit food product classes (23, pp. 44-45, 50). This percentage represents an increase from 63 to 70 percent from 1954 to 1963, less than one percentage point per year.

These data must be considered to be descriptive, background material, rather than conclusive, in evaluating any change in competition. It is not surprising that one or more of the leading positions were occupied by the 100 largest manufacturers in 114 of the 116 five-digit food product classes in the 1963 Census. Thirty-nine percent of the fifth through eighth positions were occupied by the 100 largest food manufacturers. This fact indicates a significant amount of diversification by food industries.

The 200 largest food manufacturers produced products in an average of 3.7 four-digit food industries and 3.1 four-digit nonfood industries, in 1963. The 20 largest firms were in an average of 8.9 food industries. This is an increase from 5.4 industries occupied by the 20 largest food manufacturers in 1954 (23, p. 50).

Thus, product diversification is a structural change that has been altering the shape of industries for many years. The 1966 Fortune Plant and Product Directory indicated that some food companies produced over 70 distinct, five-digit products. The same directory listed 98 firms producing food and kindred products among the 500 largest firms. These firms produced an average of 18 different, five-digit products in 1966, compared with 15 in 1961.

Diversification is not a recent phenomenon. Gort found that the 12 food companies in his sample of firms (taken from the entire universe of manufacturing firms) were producing in 78 four-digit manufacturing activities in 1947 and 81 in 1954. The average ratio of primary four-digit industry payrolls to total manufacturing payrolls for these 12 companies, that is, the proportion of their activity, so measured, in their primary food industry, was .763 in 1947 and .783 in 1954. The same 12 food manufacturing companies added 157 products and services between 1929 and 1954. Forty additions were in nonmanufacturing activities. During the same period, these 12 companies abandoned the production of 54 products and services, 23 of which were nonmanufacturing activities. Of the 64 product additions in manufacturing activities made by these 12 companies, 44 were in industries growing at least as rapidly as the company's primary industry (14, p. 61).

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[4]Ranked by value added by manufacturers in food and kindred products excluding manufacturers of alcoholic beverages.

[5]A firm is said to occupy a leading position if it is one of the eight largest producers by value added in manufacturing in a five-digit product class.

[6]Here, a firm occupies a leading position if it is one of the 4 largest producers ranked by value added in manufacturing in a four-digit industry.

We have noted that diversification has been changing the structure of industries for many years. The strength of this structural change indicates that diversification, which is related to the reallocation of resources and the growth of firms, must be included in an evaluation of competition. This structural change greatly complicates the issue because competition can no longer be evaluated solely on the basis of firms competing only with other firms producing the same product. The increased acceptance of firms of expansion into so-called conglomerate operations changes the entry patterns, as well as other patterns of competition.

General Performance Measures

It is sterile to discuss structural changes without looking at how these changes have influenced industry performance. Thus, some general aspects of performance are discussed here.

Labor productivity in the food processing industries increased significantly from 1947 to 1963. Output per man-hour,[7] an index of productivity changes, increased in food processing plants at an average annual rate of 2.4 percent per year from 1947 to 1955 (39, pp. 7-9). This same index of productivity increased at an average annual rate of 3.5 percent from 1955 to 1965. Over the entire period, the total output of the food sector increased by 20 percent while the number of man-hours worked decreased by 6 percent. The rate of improvements in output per man-hour in the food manufacturing sector was significantly greater than the rate for the total private nonfarm sector (21, p. 15). John W. Kendrick estimated that the increase in total factor productivity for food and kindred products was from 132.2 to 147.3 over the 1947-53 period (18, p. 468). Estimates for later years are not available. Kendrick's estimate gives an average annual rate of increase of 3 percent for food processing industries, compared with 3.7 percent for all manufacturing over the same period. Thus, from one point of reference, the average annual rate of increase for the food processing industries was about as good as or better than the average for total manufacturing.

Progressiveness, another measure of performance, is often determined by the extent to which an industry carries on research and development. The National Science Foundation announced that, in 1962, food and kindred products industries, although not among the highest in total dollar volume, had among the highest average annual rates of increase in R. & D. expenditures. The same source indicated that $127 million was spent for R. & D. in food and kindred products, compared with $32 million in textiles and apparel, $65 million in paper and allied products, $198 million in drugs and medicines, and $1,184 million in chemicals and allied products (24).

Markham and McFarland pointed out that firms in the largest size-class (5,000 or more employees) of food processing firms accounted for less than one-third of total food processing sales but approximately 80 percent of R. & D. expenditures made by food processing firms (21, p.99). Firms in the largest size-class spent three-tenths of 1 percent of each sales dollar on R. & D., compared with two-tenths for the middle size-class (1,000-4,999 employees) and three-hundreds of 1 percent for the smallest size-class (under 1,000 employees). The largest food firms spent ten times as much on R. & D. as the smallest firms, in terms of expenditures as a percent of sales. Markham and McFarland indicated that the 75 food processors listed in Fortune's 500 Largest Corporations accounted for "as much as 90 percent of the total" R. & D. expenditures made by food firms (21, pp. 99-100).

The general background information given above exemplifies that no clear-cut conclusions can be drawn concerning the competitive situation in the food processing sector. Such general measures as output per man-hour or extent of R. & D. expenditures by food processing firms indicate average performance relative to other U.S. industries. Both measures showed improvement over the 1950-62 period. The still-apparent fact is the large reduction in the number of companies competing during the same period. There were, simultaneously, more large companies rather than fewer.

[7]Output per man-hour has many weaknesses as an index of productivity change. It is used here, as is often done, because data were not available to construct other indices that would be better measures.

Another important measure of performance, and the one to be used in this study, is profitability. Profitability measures the extent to which a competitive market mechanism is being permitted to determine market prices and the allocation of resources.

General comparisons by industry made for the performance measures described above are not made for profitability. Data were not available to allow the development of meaningful estimates of industry profit rates. At the industry level, in today's world of diversified firms, the Census Bureau's concept of value added may be considered a suitable proxy for productive output. The problems associated with industry measures do not exist at the level of the firm unless efforts are made to assign proportions of the total profit to various product lines, a process which requires joint cost allocation. The present report investigates the effect that structural measures of profitability mentioned above have on the differences in profitability among food processing firms.

THE MODELS

Theoretical Basis

The basis for the expected relationship between market structure and performance originates in microeconomic price and welfare theory (3, pp. 44, 45). General economic efficiency and welfare are maximized (for both producers and consumers) in all "nondeclining cost industries" if all markets are characterized by pure competition, one extreme structural condition. Under such a system, it is assumed that producers attempt to maximize profits and consumers attempt to maximize satisfaction in allocating their income among goods, services, and leisure. Market-determined prices coordinate such a system and eliminate the misallocation of resources. The objectives of producer and consumer are achieved in a purely competitive economy when prices are equal to marginal cost. Competition among the atomistically structured buyers and sellers enforces efficiency on both sides of the market.[8]

Pure monopoly is considered the other extreme structural condition. There is no mechanism to enforce efficiency among both buyers and sellers in the purely monopolistic industry. The power of the firm to determine price and output is restricted only by the market demand curve and this curve can be partially altered by advertising. The only mechanism that can enforce internal efficiency and innovation is the firm's desire to maximize profits. This desire may be at odds with the consumer's desire to maximize welfare and the firm's desire to maintain its purely monopolistic position.

The important aspect of these two theoretical models is that the resultant performance under either model is based significantly on the structure of the industry described in either model. The purely competitive industry is described as one in which there are many small competitors, no one of which has enough power to influence the conditions of sale through his independent market actions. The purely monopolistic industry is defined as a 1-firm market. The firm is the industry. Thus, the firm sets the price. U.S. industries fit into neither of these logically designed norms. Instead, monopolistic competition and oligopoly characterize most narrowly defined U.S. market situations, particularly in manufacturing and processing. But a wide variety of structural patterns satisfy these broad industry classifications. Thus, the performance of these industries can be predicted only using well-specified behavioral assumptions that permit only limited generalizations. As a result, Bain, Stigler, and others have developed theories in which the static performance of an industry is predicted under various structural conditions (3, 34). Dynamic performance is more difficult to predict using preexisting structural conditions.

Bain and Stigler's thesis that expected patterns of performance result from various market structures came only after numerous attempts by other writers to break away from using the purely competitive model as a norm and as the best guide to public policy decisions. These attempts, commonly called the theories of workable competition, require the following conditions: (1) a

[8] The complete proof of this proposition can be found in any intermediate micro economics theory text.

considerable number of firms either selling closely related products or having sufficient product hetereogeneity to allow a high degree of product substitutability; (2) the firms acting without collusion; (3) a cost-demand relationship that permits firms to cover longrun average costs; and (4) an active threat of potential competition (5, p. 241; 43, pp. 2-3).[9]

All the above concepts of workable competition still attribute considerable significance to structure. The theories do not require that all structural factors conform to the purely competitive level in a narrowly defined market but rather to a level that reasonably well ensures the operation of the competitive market-offer mechanism. Under such a system, profits or losses should not be so excessive that the consumer or resourte owner is jeopardized at the expense of the monopolistic producers. But profits should be high enough to reward the producer's innovation, creativity, and risk bearing. Long-run profit differentials that exist among firms should not entirely result from the firm's market share and structure or artificial barriers to entry that may develop. Short-run differentials between the performances of firms and industries are expected and desirable.

Firms have varying abilities to cope with risk. More specifically, firms in various industries face varying degrees of risk, which are not directly accounted for in the theories of workable competition. Firms in different industries and of different lifespans have varying degrees of factor mobility and thus, varying rates of adjustment to risk and other dynamic forces. Firms may have different levels of internal efficiency caused by the possession (or lack) of scarce resources such as highly competent management. Differing degrees of efficiency could lengthen the period of any temporary difference in performance between one firm and another. In a dynamic setting, the competitive adjustments from one equilibrium to another cause differentials to exist, and the differentials, in turn, cause adjustment processes to develop. These are only a few of the possible explanations of temporary differentials. Extreme factor immobility or differences in risk could make these differentials much more permanent.

Bain pointed out that, for a workably competitive system, short-term excess profits are justified and "therapeutic" for the economy. Such profits offset short-term losses encountered in depressed periods, encourage expansion, efficient production, research, and innovation, and reward risky undertakings (3, p. 371). Chronic excess profits (or losses) cause unequal income distribution by favoring (disfavoring) enterprise owners over other recipients and by having the undesirable impact of attracting more (less) than the desired level of resources into a certain production area.

The firm's rate of profitability is used as a measure of performance throughout this study because of the above implications regarding resource allocation. The effects of structure on profitability and resource allocation are measured by using statistical techniques to determine the degree to which differences in profitability among firms are related to differences in various measures of market power that are discussed below.

The degree of industry concentration is used as evidence of market bargaining power. Oligopolistic and monopolistic power derives from a relationship between buyers and sellers in which the strength of such power depends on the number, size distribution, and conduct of the buyers and sellers. Concentration ratios are 1-parameter indices of numbers of firms and their size distributions in various markets. Some economists view these ratios as direct measures of the ordinal degree of oligopoly (28, p. 109). From this point of view, as industry concentration increases, the extent of excess profitability should increase. This viewpoint has also been used to support two contentions (other things being equal): (1) highly concentrated industries will be more profitable than less concentrated industries and (2) firms with a significant market share will have higher excess profits than firms with a less significant market share.

If these propositions concerning concentration are true, the results stated by Scitovsky will be forthcoming (28, pp. 102-110). First, income distribution is affected by the achievement of monopoly profits. This effect comes about because consumers are charged excessively high prices

[9]Edwards and Sosnick give definitions of workable competition that represent a more explicit partitioning of these concepts (8, pp. 9-10; 29, pp. 380-423).

and input suppliers are paid low prices. Second, concentration may seriously affect the allocation of resources. In a competitive market, resource allocation is regulated by the price mechanism. In an oligopolistic market, prices charged for output may be above marginal costs, and prices paid for input may be below marginal value. Price, then, no longer validly indicates scarcity of resources. The high margin between price and marginal costs permits firms in an oligopolistic industry to produce using resource mixes that are not necessarily the most efficient. Third, profit maximization calls for efficiency within the firm whatever the market structure may be. To maintain a monopolistic position, firms may charge an entry-limiting price. Doing so, however, could involve inefficiencies in the internal operation of the firm, if, by using a limiting price, firms do not adhere to the principle of profit maximization.

Scitovsky's results follow if Bain's thesis is accepted that increased concentration,that is, increased market power – short of monopoly attainment – produces performance approaching that of monopoly. To accept this thesis, one must accept the proposition that as the number of companies declines, as a firm's size increases, and as concentration increases, firms develop a "live and let live" behavior. They do not make price moves (moves that might pass efficiency on to consumers) that might lead to price wars. When fewer large firms exist, these firms are capable of following and will follow courses that do not hinder one another. They develop price leadership or other mechanisms of parallel action.

To accept Bain's thesis, one must accept a list of binding assumptions concerning behavior of firms. However, a two-firm industry could be very competitive and have good performance if the behavior of the two firms does not conform to Bain's prescriptions but rather is similar to behavior of firms in an atomistically structured industry. The hypotheses of the present study are founded on the concept that concentration ratios "...do provide an a priori basis, supported both by theory and experience for identifying markets containing significant elements of monopoly, although the extent and significance of noncompetitive elements so located must be evaluated in each case by further study" (12, p. 1263). In other words, high concentration ratios do serve as signals calling attention to particular industries, but the relationships between concentration and performance must be analyzed further, accounting for the behavior in each case, to determine whether the market has functioned as a monopolistic market.

Product diversification is a structural characteristic brought about by the conduct and perhaps performance of firms and not directly accounted for by industry concentration. Product diversification, if achieved by merger, has no direct and immediate effect on the measured concentration of either industry involved in the merger. If diversification is achieved by the internal expansion of a firm into a new area, the effect on the size distribution of firms in the area newly entered by this firm is not the same as when a firm expands by horizontal merger or acquisition.

The influence diversification may have on market performance is brought about by: (1) the firm's capacity for channeling capital into more profitable areas, that is, the competitive reallocation of capital brought about by unequal profit rates; (2) permitting the firm to use more fully its own resources, thus achieving more efficient mixes of activity and output; (3) reducing long run profit variation or risk at the possible expense of direct shortrun profit growth; and (4) giving the firm market leverage, that is, the firm's ability to influence marketing policies in one market because of its activities in another.

Absolute size of the diversified firm presents a structural feature that may or may not be related to industry concentration, but nonetheless results in a set of expected influences on performance. Absolute size of firm will have an influence on operating efficiency and profitability if either real or pecuniary economies of scale exist for the firm. These economies differ from inplant economies in their relation to overall functions of the firm.

Economies may result from the larger firm's ability to attract capital at a lower rate. Large firms may have more bargaining power than small firms in the purchase of other inputs. Large firms may be able to use R. & D. facilities more efficiently. They may have economies of scale in management, at least up to a certain level. Large firms may be able to use computer operations that reduce overhead costs.

Large companies are typically the largest advertisers[10]. They may advertise through national media, which usually yield a higher exposure rate per dollar than local advertising media. The advertising industry, historically, has given discounts to clients with large accounts. Thus, scale effects can enter through advertising.

These economies of scale for total company operation should help bring higher profit rates (32, p. 55). Company capabilities not directly related to the primary product of the company but related to overall company operation, such as attraction of lower cost capital, should yield a positive relationship between size and profit rate of the firm regardless of primary industry classification. The presence of such a relationship also means that economies of scale exist and are not offset by diseconomies of large firms. Similarly, if economies exist that are peculiar to a particular industry, the same positive relationship should exist between profit rates and size of firms within this industry.

The last concept to be considered in this study as a possible structural influence on market performance is barriers to entry. Barriers to entry that reflect characteristics of industrial organization such as large physical investment needs and scale of operations are products of the state of technology. Barriers achieved through patents or copyrights are institutional.

A barrier to entry is present any time sellers in an industry possess an advantage over firms who wish to enter that industry. The extent of the barriers determines the extent to which established firms are protected from potential competition (3, pp. 237-238). Bain says that barriers to entry may be measured by the percent the price can be raised above the competitive level without attracting new entrants (3, p. 337). Bain's concept fails to incorporate fully his later discussion of the effect of industry concentration. If the degree of industry concentration is not so high that it eliminates intraindustry competition, barriers to entry may eliminate the threat of new entry but may not hinder competition among existing firms. Therefore, barriers to entry are more aptly measured by resource requirements (2, 16, 25, 32). High capital requirements, in conjunction with high levels of concentration and highly diversified market power, should be positively related to the level of profitability.

This study considers major sources of barriers to entry that allow established firms to elevate prices above the competitive level without inducing entry. Established firms may possess "absolute" superiority over new entrants derived from: (1) control over certain production techniques, (2) buildup of market information not available to the "outside," (3) ownership of valuable resources unique or nearly unique to the production function of that industry, and (4) availability of funds from sources unwilling to promote investment in a company moving into a new area.

Economies of scale at the plant level, as well as the company level considered above, will influence the size of plant necessary for efficiency and could cause barriers to entry. Economies of scale at the plant level in food processing are believed to be limited in the sense that the minimum efficient size of plant is associated with a small percentage of industry output.

Quantity discounts in mass media advertising can significantly reduce the cost of advertising for a given exposure rate. Large volume network television advertisers receive maximum volume discounts of 25-30 percent off regular rates. Smaller discounts are available in other media (10, pp. 44-45). The large company can also afford prime-time advertising, which reportedly provides a higher exposure rate.

Advertising presents a barrier to entry in three respects. First, advertising is a form of capital in the marketing process. This kind of capital is more prone to uncertainty than capital in buildings

[10]In this paper, the terms "company" and "firm" are used interchangeably.

or equipment because its effects are unknown. Therefore, the company must be willing to place large amounts of money in uncertain ventures.

Second, advertising has a cumulative effect on the market. Palda found that it took almost seven years for an advertising dollar to exhaust 95 percent of its sales-generating potential (26, pp. 162-179). The cumulative effect of brand and special label promotion must be overcome by the entrant if he is to capture a significant share of the market.

Third, advertising is a means of product differentiation that creates brand preferences or company allegiances in the minds of consumers. This facet of advertising is usually considered a measure of market conduct but it also functions as a company-contrived barrier to entry. In recent years, advertising as a noncompetitive tool has drawn increased attention from economists and policy makers. Of particular concern are the effects advertising could have on the maximization of consumer satisfaction which ". . .has traditionally been regarded as the primary criterion for evaluating the economic system" (12, p. 1257).

Advertising may be undertaken by a firm for any one of a combination of reasons. Some possibilities are: (1) to expand the market for the product, (2) to expand the firm's market share, or (3) to change the shape or location of the demand curve.

Advertising may take on any of three forms: (1) a purveyor of information about price, quality, and physical appearance; (2) a means of persuading consumers that a product differs merely because it is produced by a certain enterprise; and (3) a direct barrier to entry. If advertising is effective in achieving its purposes, a positive relationship between the level of advertising and the rate of profitability should exist.

Development of the Main Model

The model was developed to seek an identification of any systematic relationships that might exist between structural conditions and profitability.

The model was tested with cross-sectional data. The cross section gives one view of the "long-run" situation since the data represent firms of varying sizes operating plants that are subject to similar potential technological conditions, price conditions, and other exogenous forces.[11] Differences in the age of assets, the extent of divisibility of processes, and so on, may or may not allow one firm to move to the position of another. But since this other firm has moved to the position it now maintains, one must assume, if cross-sectional analysis is to have any validity, that other firms, in turn, could move into this firm's position. Time-series analysis, in comparison, indicates how the firm has adapted, through time, to changes in technology, marketing conditions, and other exogenous forces, but does not maintain the usual conditions of long-run analysis (that other things remain equal).

A major deviation of this particular model from previous ones is that it uses the firm as a unit of measure rather than the industry average. This deviation allows a comparison to be made between large firms in industries of differing structures. The existence of noncompetitive performance should be reflected in differences between large firms with many competitors and large firms with few competitors. If structural features are valid indicators of performance, the differences should be most extreme between large firms with many competitors and large firms with few competitors.

The problem of using aggregative data is exemplified by the information given in table 3. Data in this table were compared with results of similar comparisons of unaveraged or ungrouped observations presented later in the report. It then became obvious that averaging and grouping have a substantial influence on the level of the variables being measured.

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[11] Some people maintain that cross-sectional analysis presents the best representation of the long-run situation (7, p. 362).

Table 3.—Average net profit/net worth ratio by size of firm, 134 food processing firms, 1964/65

Asset size (millions)	Number of firms	Average profit/net worth ratio
0-9.9	37	.082
10-24.9	27	.117
25-49.9	14	.115
50-99.9	18	.083
100-249.9	18	.120
250-499.9	13	.122
Greater than 500	7	.133
Total	134	.104

The use of industry averages, particularly to measure profitability, has two major weaknesses. First, such use eliminates all within industry variation which may or may not overwhelm any between industry variation. Second, if the within industry variation is large, use of the mean or average could represent the true relationship poorly. Or the residual level of variation could more than compensate for the loss in degrees of freedom that results when the average is used. Thus, spurious levels of significance may result whenever an attempt is made to relate results of such averaging tests to individual members of the averaged groups.

A related problem to that of using aggregative data is that of finding an acceptable and meaningful industry profit rate. Government sources of profit data are published primarily at the three-digit level. Published structural data are most useful at the four- and five-digit level. Profit data published by the Internal Revenue Service have an added difficulty introduced by the partial and complete consolidation of corporate tax returns.[12] Some successful attempts have been made at constructing and using average industry profit rates but further use must be with great caution (30, 31).

The above information indicates a potential significance of company organization that cannot be related to any one industry — product diversification. When the firm is the unit of measure, comparisons can be made between the profitabilities of diversified and nondiversified firms. Use of this unit of measure also permits direct representation of absolute size of firm.

Variables in the Main Model

Two measures of profitability were used in the study as dependent variables against which the structural variables were regressed to show the presence of resource allocation. The ratio of net profit to net worth was used as the factor that management should be maximizing if it is acting in the best interest of profit-maximizing owners.[13]

[12] The level of partial consolidation is never indicated by IRS. Thus, how well their series corresponds to Census specialization and coverage ratios is unknown.

[13] This ratio of net profit to net worth is not a perfect measure of profitability. The ratio probably tends to understate real profit rates for, among others, the following reasons: (1) Part of monopoly earnings may be paid in the form of excess compensation to officers; (2) accounting conventions used to measure depreciation may not reflect only the cost of capital; and (3) advertising has cumulative effects and probably should be either depreciated or amortized rather than treated entirely as a current cost. In addition to these three errors, measurement errors are made when comparing firms. These errors are caused by the use of different accounting procedures among firms. Economic measurement is also hindered because accounting profits represent annual averages. From an economic point of view, the 12-month period is a rather arbitrarily selected time period and not necessarily the period over which firms maximize profits.

In the ratio, the numerator represents net total revenue minus total costs; that is, the numerator includes both normal profits and excess profits or losses. The denominator, net worth, measures the cumulative amount of funds that have been invested in the firm. This amount measures the amount of funds that could have been invested elsewhere, or, at least in part, distributed to the stockholders for investment elsewhere. Therefore, the amount provides a basis for the opportunity—cost doctrine. Thus, the ratio, net profit to net worth, represents the return that is attracting or detracting funds from this area of production.[14]

The ratios of net profit after taxes to net worth for the firms being studied were taken from Moody's Industrial Manual for the 1964-65 fiscal year of the corporations.

The variable, average gross margin, was substituted for net profit rate as a measure of the spread between average direct (variable) costs and average selling price. This spread is measured empirically as the difference between total revenue and the cost of goods sold. The variable, cost of goods sold, includes materials, labor, inventories, and, in some cases, other direct costs. Average gross margin is a proxy measure of the extent to which firms can price above direct costs. This proxy measure is similar to the marginal cost—price comparison suggested by Lerner as a measure of monopoly (19, pp. 157-175). As monopoly power increases, average gross margin presumably increases. A high average gross margin also presumably indicates an ability to erect general barriers to entry and achieve product diversification by advertising. Average gross margin, unfortunately, reflects certain factors other than those associated with monopoly power. For example, average gross margin will vary with the degree of initial integration and likewise with the shape of the cost curve. The data could not be corrected to allow for these problems. Thus, one must interpret the results with these shortcomings in mind. In conclusion, the variable, average gross margin, and the ratio of net profit to net worth should both have a positive relationship to structural measures of the firm if monopoly elements of behavior are present and if measurement shortcomings are not significantly present.[15]

The independent variables can be grouped into three categories: those describing size and concentration, those describing diversification, and those describing barriers to entry. The first and second group of variables will be discussed separately from the third group.

The four firm, four-digit industry concentration ratio of the firms' primary industry was introduced into the model to determine the existence (or lack) of a relationship between profitability and concentration.[16] The firms were classified into a four-digit industry. The number of industries in which the firm operates was ranked by the number of employees in each industry. Then the company was assigned to the industry in which it had the largest number of employees.[17]

Primary industry concentration ratios do not account for the possibility of a relationship between structure and number of activities engaged in by a firm and profitability. Diversification may take two forms: expansion into a new geographic market with no change in products

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[14]Profit data presented in numerous forms by Stekler for the food industries indicate that when firms are ranked by asset size, profit rates reach a maximum in the $50-100 million asset category for all measures of profit so ranked (30). Thus, consistency seems to become more important if all measures move in a somewhat proportional manner.

[15] Data limitations and measurement problems do not allow one to account directly for the influence of risk on performance variables. Therefore, we must assume that risk affects all food manufacturing firms similarily. Although this assumption is somewhat unrealistic, it has become common practice in industrial organization studies. Any reduction in the cost of capital brought about by the lessened risk of a large firm with monopoly power or diversified activities should be reflected in the relationship between profit rates and these variables, but such a reduction cannot, with the current model, be separated from other structural features (41).

[16]Data for this variable were taken from (37).

[17]The McGraw-Hill Plant Census was the main source for classification purposes. Annual reports, financial periodicals, and trade publications also were used.

(geographic diversification) and expansion into a new product line (product diversification). Only product diversification will be considered here.

A serious taxonomic problem arises in defining product diversification. When is a product sufficiently different from other products of a firm to indicate that diversification exists in the firm? There is no simple answer. In this paper, diversification refers to production of any two or more products by a firm where the products are not close substitutes of the firm's primary product, either in vertical or horizontal characteristics. The four-digit Standard Industrial Classification was used for analytical measurement, after taking account of vertical integration.

For our purposes, there are numerous weaknesses in the four-digit SIC. First, the degree of "node commonality" cannot be measured directly by such a classification scheme![18] Some of the influence of varying degrees of product relatedness was accounted for by making minor adjustments to the four-digit SIC. Second, there are differences in the relatedness of products within four-digit industries. Each four-digit industry is not a clean, homogeneous group of products. Again, some of this problem was removed by adjustments to the four-digit SIC.

Other weaknesses are involved in drawing the line at the four-digit classification rather than the three- or five-digit. The four-digit level was chosen, in light of these weaknesses, because it most nearly represented the degree of node commonality desired for this study; that is, the four-digit level gives a significant separation of the various activities of the firm and is the level at which data are most readily available.

Other measures of product diversification were rejected because of problems they introduced. One of these, commonly used, is a simple count of the number of products produced by a company at a given level of classification. This measure avoids the serious problem of estimating the breakdown in volume output of each company. However, it is a grave error to neglect the volume of the firm's output in each product line—one of the important dimensions of diversification. Thus, the simple count measure was not used in this study.

Another possible measure is that of weighting the volume of output in each product line by the inverse of the number of product lines. The result is then divided by the total output. Merits of this weighting system are outweighed by problems of interpreting the results. Firms numbered one through five in the following tabulation have outputs in industries A through E in the amounts designated:

Industry/Firm	1	2	3	4	5
A	100	51	80	20	40
B		49	5	20	40
C			5	20	10
D			5	20	10
E			5	20	
Total (output)	100	100	100	100	100

[18]If each firm is viewed as a collection of elements "each of which has some output or capacity" and "if we designate each location of an element" along a spectrum, ranked by relatedness, as a node, then "the degree of product relationship is the degree of node commonality that exists" between the various activities of a firm (22, pp. 3-7).

Using the weighting system, firm 1 has a diversification index of 1, firm 2 has an index of .5, firm 3 has .2, firm 4 has .2, and firm 5 has .25.

The straightforward interpretation seems to be that as the level of diversification increases, the index approaches zero. The same results can be achieved by ranking a firm's output in each product line and assigning declining weights from larger to smaller output. Other systems of weights could achieve the same results; that is, as the level of diversification increases, the index approaches zero. However, each weighting system would impose a certain arbitrary ranking or weighting of the profitability or productivity of each product line. In table 4, since the profitability of each product line was not known, the simple weight of one was attached to each product line.

Diversification through market extension is not considered separately here. All markets are considered to be national markets for purposes of concentration measures. This assumption is probably most seriously challenged by the bakery and dairy industries. Other studies have maintained that national concentration ratios usuallv mean less where strong regional markets exist (7, pp. 31-32; 36, pp. 720-721). The lack of reliable regional data was a strong reason for not measuring regional competition in this study.

The extent to which a firm has a diversified product mix and the structure of the industries into which the firm is diversified must be accounted for as separate structural forces that possibly influence profitability.

The extent of product diversification is measured by the ratio of nonprimary sales to total sales, multiplied by the number of four-digit industries in which the company has products. This ratio measures the extent of output accounted for by nonprimary products. The number of four-digit industries in which the company has products measures breadth of diversification.

The ratio of nonprimary sales to total sales was developed by multiplying the number of employees at each plant by the value of shipments per employee. The value of shipments per employee (as a proxy for sales) was the average for a plant of the size–class and four-digit industry in which each plant had been classified in the 1963 Census of Manufacturers. Total value of these shipments was then computed for each company and its subsidiaries. The four-digit industry with the largest output was considered the primary industry. The amount of this output was subtracted from the total to arrive at the nonprimary sales used in the ratio. A second variable was formed by weighting this ratio by the number of four-digit industries the firm was in.[19]

A weighted concentration ratio was calculated to account for the structure of the industries into which the firm is moving. The four-firm concentration ratio of each industry was weighted by the output of the firm in the same industry. Thus, the variable is $\Sigma a_i c_i$, where a_i is the share of the firm's employment in the ith industry, and c_i is the 4-firm concentration ratio for that industry. This variable then forms a weighted concentration ratio in which the concentration ratio of each industry in which the firm operates is being weighted by the share of the firm's employment in that

[19] There is no a priori reason for assigning weights of one to each product. Doing so provides an equal weight for all products regardless of the similarity of the product to the primary product or other products of the company. This is not necessarily the most accurate weighting procedure, but since there is also no a priori reason to use any particular nonlinear weighting scheme, the linear scheme was chosen. Of any of the possible weighting schemes, the linear scheme provides the simplest interpretation.

industry.[20] Total employment for each company and its subsidiaries was developed by summing the plant totals. The percent of company output in each four-digit industry was then approximated by using the ratio of employees each company had in each four-digit industry (numerator) to total employment for each company and its subsidiaries (denominator). Nonmanufacturing activities, including central administrative offices and services, were excluded from both the numerator and the totals used in the denominator.[21]

The level of the diversification data is understated because each plant, whether single or multiproduct, was classified into one four-digit industry.[22]

Absolute size of firm was entered in the model as an independent variable to account for size differences among firms within industries, as well as for the influence size of firm might have on profitability, regardless of industry, such as through increased purchasing power or reduced capital costs. Absolute size of firm was measured by total assets, both current and fixed, minus accumulated depreciation.[23]

The model contains three variables that reflect capital barriers to entry in food processing industries. The size of existing firms that was mentioned above also reflects the amount of total resources against which a new firm must compete. In addition to this, the minimum efficient size of plant and the level of advertising were introduced as variables representing other entry barriers.

The minimum efficient size of plant was determined with the survival technique, which involves classifying the plants in an industry by size and calculating the share of industry output coming from each class over time.[24] If the share of output coming from a given size-class declines over time, the size–class does not represent efficient-sized plants (27, pp. 91-100; 32, p. 54; 40, p. 246). Proceeding from the smallest size--class upward to the larger ones, the first class in which plant output as a percentage of total industry output does not decline represents the minimum efficient size of plant in that four-digit industry.

The survival criterion assumes that inefficient plants neither survive nor remain at their current level. They must grow or decline in size to the efficient level if they are to survive. This criterion is a weak test because it is totally an examination based on past performance and may have little, if any, predictive ability. Second, the minimum efficient size may be very sensitive to the boundaries placed on the size-classes. In view of these weaknesses, we hypothesize that a positive relationship exists between the minimum efficient size of plant and the profitability of the firm. Such a

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[20]The weights used in the weighted, diversified index and other diversification variables were calculated from data in the McGraw-Hill Plant Census, Hightstown, N. J. This Census includes over 85 percent of manufacturing employees and 88 percent of value added by manufacture. A list of individual plants belonging to the companies in the population described above was supplied to McGraw-Hill. They, in turn, classified each plant into one four-digit industry and indicated the number of production employees at the plant. Coverage of the total employment of any given company was considered sufficient for the development of the diversification indices, if data were available for 80-85 percent of the production plants on our list for that company. The plants for which McGraw-Hill did not have data and the plants not covered on our list were assumed to be distributed randomly among the company's primary and nonprimary activities. Various distributions of these data are presented in Appendix B.

[21]The multiplying tendency of the weighting system was chosen because of the lack of any a priori reason to choose another system. Certain empirical effects of this weighting system that are currently being studied suggest the need for a more elaborate weighting system.

[22]The data necessary to prove this bias statistically were not available. Where checks could be made, it seemed that a number of multiproduct plants were placed in the classification of the primary product of the company. (Such placement occurred if the company's primary product was produced by the multiproduct plant).

[23]These data were taken from Moody's Industrial Manual.

[24]The data for this variable were taken from (23, pp. 97-99).

relationship should exist, because as the barriers to entry at the plant level increase, the firm is able to raise the "limit" price and achieve higher rates of profitability.

Two advertising variables were introduced into the model. Since the effects of advertising are cumulative, total advertising and promotional expenditures of the firm over a 5-year period was used as an independent variable to account for most of the advertising effects that would have to be overcome by new entrants or growing firms (26, pp. 162-179).[25]

The second advertising variable, the ratio of current advertising to total revenue, accounts for the amount of revenue gained through sale of products that must be devoted to promotion and to selling expense (Bain's term)(3).

The last variable introduced into the model was the capital output ratio, added at the suggestion of Collins and Preston, to adjust for different levels of firms' capital intensity (36, p. 717). The level of capital intensity could cause a difference in profitability. Depreciation, included in the ratio, profit to net worth, may be higher in each industry that has a higher level of capital intensity. This possibility assumes that their capital is owned and not leased. Barriers to entry also tend to be higher if firms or industries have higher levels of capital intensity (6). The capital output ratio is measured by the ratio of fixed capital to net sales.

Data used in these variables were collected for 182 publicly held corporations. These corporations were either (1) registered with the Securities and Exchange Commission and listed in Moody's Industrial Manual (1966) as food processors or (2) listed in the Fortune Plant and Product Directory (1966) of the 1,000 largest manufacturing corporations because they had some operations classified in food industries. Cooperatives were eliminated from the study because of their differences in accounting and reporting techniques. Other companies were eliminated because certain crucial data were lacking, financial records were not comparable, or the firms could not be classified by products. The firms used in the study represent the population of publicly held corporations engaged in food processing. The elimination process left 180 firms that were distributed among the three-digit food industries as follows: 20 corporations primarily classified in meat packing (SIC 201), 19 in dairy products (202), 30 in canned and frozen fruits and vegetables (203), 27 in grain milling (204), 19 in baking (205), 25 in miscellaneous food products, and 40 primarily in nonfood manufacturing. Because some variables could not be obtained for certain firms, the sample size was changed to test for various correlations. [26]

This population of firms was chosen because: (1) Financial reports are filed annually with the Securities and Exchange Commission and are published in Moody's Manual;[27] (2) partnerships and proprietorships are not considered in the present study; and (3) the firms chosen account for a sizable segment of the output of manufactured food products. They are the industry leaders. Thus they could possess market power individually or be strong enough to compete with other very large firms in the market.

[25] Advertising data were taken from ERS research.

[26] Changes in the sample size will be indicated in the text. Other measures of the distribution are presented in Appendix B.

[27] Moody's manual indicates changes in accounting procedures, ownership, control, and so forth.

The Complete Set of Variables Summarized

The complete model includes eight variables. The ratio of net profit to net worth is the dependent variable Y:

Equation 1—$Y_{1i} = f(X_{1i}, X_{2i}, X_{3i}, X_{4i}, X_{5i}, X_{6i}, X_{7i})$

X_{1i} = the four-firm concentration ratio of the ith firm's primary four-digit industry

X_{2i} = diversified power index, $\Sigma a_i c_i$, for the ith firm

X_{3i} = total assets of the ith firm

X_{4i} = minimum optimum size plant in the ith firm's primary industry

X_{5i} = 5-year advertising of ith firm

X_{6i} = current advertising/sales of ith firm

X_{7i} = capital/output of ith firm

The model was tested using a computerized, linear regression program. When the linear relationship seemed too stringent, a quadratic was fitted. The computer program presented as a result the simple correlation matrix that is used to give a picture of intercorrelation and an indication of the separate influence each variable has on the dependent variable. From a statistical point of view, we are concerned with five measures: (1) The sign of the regression coefficients, (2) whether the regression coefficients are significantly different from zero, (3) the extent that variables in the model explain the variation in profitability (the R^2), (4) changes in R^2 as different variations of the model are used, and (5) the partial correlation coefficients that indicate the importance of each independent variable.

Results of these five measures could not all be attained directly from one regression model, because of data limitations. Three variations of the model were tested, starting with a sample of 180 observations, to determine the relationship between Y, and X_1, and X_3, as below:

Equation 2—$Y = f(X_1, X_3)$

Data for 104 firms were available to test the model explained in equation 3. The firms were distributed among three-digit industry groups as follows: 19 firms in meat packing (201), 11 in dairy products (202), 22 in canned and frozen fruits and vegetables (203), 20 in grain milling (204), 15 in baking (205), and 17 in miscellaneous food products.

Equation 3—$Y = f(X_1, X_2, X_3, X_4, X_7)$

Data on all the variables necessary to explain the model in equation 1 were available for only 44 firms.[28]

The regressions in equations 2 and 3 were tested in the manner described above but with average gross margin as the dependent variable.

[28]Because of the statistical bias associated with this small sample, the results are reported in Appendix A. The small sample included only the largest firms in the population described earlier. This sample included seven firms in industry group 201, six in 202, five in 203, 13 in 204, 11 in 205 and two in miscellaneous food products.

RESULTS OF THE MAIN MODEL

Results from the three variations are presented in the order in which the variables were introduced into the system. Before presenting the results, however, the author must emphasize that the model has been developed to determine if systematic relationships exist between structural differentials among firms and the industries to which they belong and profitability differentials among the firms.

Relationships Between Profitability and Structure

First, the profit rate of each firm was related to the primary industry concentration ratio. This was done first for the 134 firms primarily classified in food products industries.[29]

The simple correlation between profitability and primary industry concentration was found to have a correlation coefficient of .039 that was nonsignificant at the 90-percent level. This finding indicates no reason to believe that a linear function describes the true relationship between rate of profitability and primary industry concentration of the food processing firms. Plotting the points did not reveal any evidence of the relationship taking on other simple forms such as that of the quadratic.

The correlation between profitability and primary industry concentration was tested with the addition of 40 firms. These firms were primarily classified in nonfood industries, but had food processing operations. In this test, the simple correlation, although still low, was positive and significant at the 95-percent level. This finding indicates that the positive relationship found between primary industry concentration and profitability was not due to chance. These 40 firms were typically higher profit firms and in more highly concentrated industries than the 134 firms primarily classified in food processing industries.

The lack of any significant correlation between the profit rates of food processing firms and the concentration of the industries into which the firms are classified could be caused by low profit rates accruing to the smaller firms (in the sample) that were classified as being in the highly concentrated industries. Size of firm was introduced to account for such possibility. Because the sample is a multi industry one, size of firm (as used in this study), does not alone account for this possibility. First, we could expect profitability to vary with size of firm, regardless of type of industry, because of economies such as those involved in accumulating capital. Second, the profit rate within an industry could vary considerably, because the larger firms are either more or less efficient than smaller firms or are exerting monopoly power over smaller firms. The first possibility would yield a positive correlation between profit rates and size of firm, regardless of industry. The second possibility was tested with analysis of variance and intra industry correlations.

The tests conducted with regression analysis indicated that no significant relationship existed between the rate of net profitability of firms and the respective size of these firms for the 134 food processing firms. The simple correlation coefficient again displayed a positive sign but this was .107, which indicates that the coefficient is nonsignificantly different from zero at the 90-percent level. All simple correlation coefficients for the study firms are summarized as follows:

	X_1	X_3	X_4	Y_1
X_1	1	-0.056	0.412	0.039
X_3		1	-0.100	0.107
X_4			1	0.097
Y_1				1

[29] Firms classified in nonalcoholic beverage (soft drink) industries were eliminated because of classification and measurement problems. Two firms were eliminated from industry group 203, one from 204, one from 205, and two from miscellaneous food products, because of classification problems associated with concentration ratios for these firms.

The lack of a statistically significant correlation between size of firm and level of profitability is consistent with the findings of Stekler (30, p. 30). Although his distribution of the ratio of profits to net worth does indicate an increase in this ratio as the asset size increases, the firms in the largest size-class are not the most profitable. The positive relationship is particularly strong until firms reach asset ranks of $500,000 to $1 million. The relationship then falls off significantly with an increase of less than 1.5 percentage points for firms with assets ranging from $5 million to over $100 million.

The highest level of profitability appeared in the group that had assets of $50-100 million during the years studied by Stekler. The four largest firms in each 3-digit industry group, including meat packing, had assets in excess of $100 million. Exceptions were one firm in each of the following industry groups: dairy products, canning/preserving, frozen fruits and vegetables, and grain mill products, and two of the largest bakery product firms (38). Various measures of profitability used by Stekler never yielded the highest profit rates for the largest size category of food processing firms. The smallest firms definitely made the lowest profits. However, Stekler considered much smaller firms than were included in this study. Firms in this study fell primarily along the flat portion of the curve of Stekler's size profit distribution.

An analysis of variance was run to determine the relation of profit variability within industries to profit variability between industries. The analysis was run on five 3-digit industries.[30] The ratio, net profit to net worth, was used as a random variable. The results are presented in table 4. The calculated F value of 1.78 gives no reason to believe that profit variation among these industries is significantly different than profit variation within the industries.

Table 4.—Analysis of variance of profits for five 3-digit food processing industries, 1964/65

Source of variation	Degrees of freedom	Sum of squares	Mean square
Mean	1	1.099	1.099
Among industries	5	.081	.016
Within industries	131	1.191	.009
Total	137	2.372	

Note: F = 1.78.

A further test was run because of the possible influence a nonnormal distribution of profit rates might have on the results. A weighted concentration ratio was calculated for each three-digit industry.[31] The three-digit industries were then ranked first by concentration and second by average profit rates. A nonsignificant relationship was found between the two rankings, using a Spearman rank correlation coefficient test. For the firms used in this study, the average profit in the most highly concentrated food industry group was not the highest nor was the average profit rate in the most unconcentrated industry group, the lowest.

The analysis of variance presented above was recalculated for 26 four-digit food industries. Again, no significant difference was found between the variability of profits of the large corporate firms within or among the industries in this study.[32]

[30] The industries were as follows: meat products; dairy products; canned, preserved, and frozen fruits and vegetables; grain mill products; bakery products; and other food products. Alcoholic beverage industries were excluded.

[31] The four-digit industry concentration ratios within a specific three-digit industry were weighted by the size of the four-digit industry, and an average was calculated for each three-digit industry group.

[32] Test results were nonsignificant at the 90-percent level.

The average level of profit within each of these same 26 four-digit food industries was calculated and ranked from the highest level to the lowest level. Similarly, the respective four-firm concentration ratios for each industry were ranked, and Spearman's rank correlation coefficient calculated. The nonparametric test yielded nonsignificant results, indicating the independence of the two rankings.

The estimate of equation 2 yielded:

$$\text{Equation 4--}\hat{Y} = .0605 + \underset{(.72)}{.0507\, X_1} + \underset{(1.28)}{.0000009\, X_3}$$[33]

The R^2 of .02, that is, 2 percent of the variation in profitability, is explained by a linear relationship between profitability and company size.[34]

The introduction of the capital output ratio, as suggested by the work of Collins and Preston (6) to adjust for different levels of capital used, produced the following equation:

$$\text{Equation 5--}\hat{Y} = .0848 + \underset{(.976)}{.0869\, X_1} + \underset{(1.42)}{.000001\, X_3} - \underset{(-1.56)}{.1846\, X_7}$$

R^2 was .03. This equation indicates that the coefficient for the size of firm variable is significantly different from zero at the 90-percent level of confidence. However, the inability of the equation to explain more than 3 percent of the variation in profitability denotes the weakness or lack of relationship between the explanatory variables and the level of company profitability.

The variables were transformed into natural logarithms to test for a nonlinear relationship, but both the t values and the R^2 remained nonsignificant at the 90-percent confidence level. For this test, all firms with a negative profit were eliminated.

Next, a multiple regression was run for each 3-digit group of industries, in an effort to determine how much profit variability of firms within each group could be explained by the asset size of the firms within each group. Although the coefficients were all positive when the size of firm variable was used, the highest correlation coefficients for the quadratic forms in the five industry groups was .26, which is statistically nonsignificant at the 90-percent level of confidence when the various sample sizes are used. Thus, coefficients were not significantly different from zero. Profit variability, as measured by the net profit to net worth ratio, cannot be explained by size variability among large corporate firms within the respective industries in this study.[35]

It was important that the coefficient on the variable used to measure size of firm (without industry distinction) had a high probability of being nonzero and positive in this more fully identified model that accounted for differences in capital intensities.

Weiss and Hall measured the size of firm variable (without industry distinction) in a manner similar to the one used in this study. They found a significant, positive relationship between size of firm and level of profitability for approximately 500 of the largest U.S. manufacturing corporations (41). They also found the size of firm variable to be a more significant explanatory factor of differences in profitability than the industry concentration variable (41, pp. 329-330). Partial correlation coefficients used in the present study show the same findings. However, both explanatory variables—size of firm and industry concentration—are much less significant in the present study, which is limited to food processing firms.

[33] The t values are given in parentheses in both equations.

[34] A primary industry concentration ratio using 20 firms was substituted for the four-firm concentration ratio because the 20-firm ratio covered a wider range of size distribution of firms within industries. The multiple, R^2 and the level of significance of the coefficients were not changed significantly.

[35] It must be recalled again that the firms in this study are all large firms.

Possibly, the diversified power index did not give adequate weight to the influence of the structure of a company's primary industry. Thus, an additional variable was calculated, $X_2' = \Sigma a_j c_j$, where $a_j c_j = (\Sigma a_i c_i) - a_p c_p$. In the equation, a_p was the share of the firm's output in the company's primary industry and c_p, the concentration of that industry. The simple correlation between $\Sigma a_j c_j$ and the ratio of net profit to net worth was .12, which is still nonsignificant at the 95-percent level. However, this correlation is higher than the correlation for any other measures of diversification and the ratio, net profit to net worth.

The purpose of using the additional variable was not to reveal information in a simple correlation. Instead, such use allows primary industry concentration to enter with a weight of one and allows concentration of industries that account for other manufacturing activities of the firm to be weighted by their respective share of that firm's total employment in manufacturing industries. The estimated equation was as follows:

$$\text{Equation 8—}\hat{Y} = \underset{}{.0483} + \underset{(1.53)}{.1108\ X_1} + \underset{(0.59)}{.0013\ X_2'}$$

R^2 was less than .04. Interestingly, the primary industry concentration ratio becomes significantly different from zero at the 95-percent level in this equation. However, the low level of R^2 shows that the hypothesized equation does not represent the true relationship between the variables included.

- The lack of within industry correlation between size of firm and level of profitability and the presence of a weak correlation between these two variables, regardless of industry, indicated that conclusions other than the usual simple, monopoly oriented ones must be drawn from these tests.

After estimating results of equation 2, we conclude that, for firms, it is more advantageous to be large than to be in a highly concentrated industry.[36] Weiss and Hall noted that such advantages could be caused by a reduced cost of capital for large firms (41, p. 330).

Simple Correlation Between Measures of Diversification and Profitability

The weighted concentration ratio, $\Sigma\ a_i c_i$, was introduced to account for not only the structure of the firm's primary industry but also the structure of other industries and the extent to which the firm is diversified into these industries (as described in the previous section). To avoid repetitively accounting for the primary industry structure, the primary industry concentration ratio as a separate variable was eliminated from the estimation equation, making the equation:

$$\text{Equation 6—}Y = a_1 + a_2 X_2 + a_3 X_3 + a_7 X_7$$

The simple correlation between the weighted concentration ratio and level of profitability was .06, which is nonsignificant at the 90-percent level.

A quadratic relationship was fitted between profitability and weighted concentration, as suggested in the National Commission on Food Marketing Report (23, pp. 205-209). The least squares estimation produced the following equation:

$$\text{Equation 7—}Y = .051 + \underset{(0.625)}{.235\ X_2} - \underset{(-0.505)}{.224\ X_2^2}$$[37]

This equation explained less than 1 percent of the variation in profitability. The regression coefficients were not significantly different from zero at the 90-percent level.

[36] The simple correlation between size and concentration for the 134 food processing firms was -.056.

[37] This equation can be compared to the equation $Y = .0746 + .4881\ X_2^2 - .2360 X_2^2$ reported by NCFM (23). A five-digit, rather than four-digit, product breakdown was used (32). Averaging procedures used in the NCFM report significantly increased the level of R^2, given in their report. A complete discussion of this averaging process and its shortcomings is beyond the scope of this paper but is being prepared by the author for presentation elsewhere.

A third weighting scheme was substituted for X_2, the diversified power index, again in an effort to clarify the relationship between diversification and profitability. This measure, $X_2'' = \Sigma a_i b_i$, where a_i is the share of the firm's output in the ith industry and b_i, the share of ith industry accounted for by the firm, relates directly to the firm's market share in variou industries. No systematic relationship could be found between this variable (X_2) and firm profitability.

The variables X_2, X_2', and X_2'' each account for some aspect of the structure into which the firm is diversified. The level of diversification (as discussed earlier) may have an independent influence on profitability not accounted for in these variables.

Table 5 summarizes the simple correlation coefficients between two measures of the extent of diversification: size of firm and the ratio, net profit to net worth.

Table 5.—Simple correlation coefficients for diversification, size, and profitability for 104 food processing companies, 1964/65

Correlation coefficients	D_1 [1]	D_2 [2]	Asset size	Net profit / Net worth
D_1	1	.7452[3]	.6284[3]	.0848
D_2		1	.7211[3]	.0512
Asset size			1	.0913
Net profit / Net worth				1

[1] $D_1 = \frac{\text{nonprimary employment}}{\text{total manufacturing employment}}$ The variable, total manufacturing employment, accounts for one dimension of diversification.

[2] $D_2 = (D_1)d$ Here, d equals the number of four-digit industries in which the firm is an active producer. This variable accounts for the composite dimensions of diversification.

[3] Statistically significant at the 90-percent level.

The correlations show that no linear relationship existed between the degree of diversification and the level of profitability for the large firms in food processing. Large firms were more diversified than small firms. This finding is completely consistent with that of Gort, who also concluded that no systematic relationship existed between the rate of profitability and the level of diversification in his sample of 111 large manufacturing firms (14, p. 65).

A strong word of caution must be injected regarding the extension of these results to cover other conclusions. Since the firms being studied represent a cross-section sample, we can say that diversified firms are no more profitable than nondiversified firms. However, we cannot conclude from these tests that diversification did or did not increase the level of profitability in the firms. Diversification is known to have increased the level of profitability in many firms and to have reversed the decline in profitability for others. This known effect of diversification, along with the results discussed in this study, indicate that product diversification is a mechanism through which large firms reallocate capital by making new investments in areas more profitable than those currently being entered. If the above indications are true, they would cause profits of the diversifier to approach the profit level of the single product firm in the higher profit area, but would not make the diversified firm more profitable. However, diversification could significantly affect the stability of the firm.

RESULTS OF EQUATION 3

Substitution of the weighted concentration ratio, X_2, for the firm's primary industry concentration ratio, X_1, yielded the estimation equation:

$$\text{Equation } 3'\text{—}\hat{Y} = .0789 - \underset{(.53398)}{.0419X_2} + \underset{(.6683)}{.00000043X_3}$$

R^2 was .008. Thus, the weighted concentration ratio explained a smaller portion of the variation in profitability than did the primary industry concentration ratio. For this reason, variables X_1 and X_2' were used in equation 3 when variables X_4 and X_7 were included. Such use gives more weight to primary industry concentration than to each of the diversified activities, regardless of their absolute magnitude.

The estimation of equation 3 was then as follows:

$$\text{Equation 9—Y} = .0737 + \underset{(.080)}{.0063X_1} + \underset{(.778)}{.0020X_2'} + \underset{(.309)}{.00000026X_3} + \underset{(.894)}{1.439X_4} + \underset{(.150)}{.0182X_7}$$

R^2 was .03. Again, the estimation indicates that the differentials between structural variables among the firms included in the linear model fail to display a systematic relationship to the differential levels of profitability among the firms in the model. The t values (given in parentheses) show that standard errors of regression coefficients were very large, relative to the size of the coefficients. These errors made the regression coefficients highly unreliable. The substitution of X_2'' for X_2 had a nonsignificant effect on the regression coefficients and the multiple correlation coefficient.

To determine the influence of diversification on the variability of profits over time, the firms were ranked ordinally on the basis of product diversification and placed in four groups. Group I contained those firms that were completely undiversified from 1947 to 1965; Group II was composed of firms that were nondiversified in 1947 but diversified in 1965; Group III was made up of firms that were slightly diversified in 1947 but witnessed a major increase in the degree of diversification between 1947 and 1965; and Group IV had firms that were heavily diversified over the entire period. This grouping placed 16 firms in Group I, 21 in Group II, 10 in Group III, and 12 in Group IV.

The first hypothesis tested was that diversified firms were more profitable over time than nondiversified firms. This hypothesis was tested with a 4 X 3 chi-square contingency table. The rows of the table represented the four groups of firms. The columns represented three profit ranges from 1947 to 1965: Low profit rates were for firms with average profits less than 5.5 percent; medium profit rates were firms with profits between 5.5 and 12 percent; and high profit rates were firms with profits over 12 percent. The contingency table yielded a chi-square coefficient of 4.53. Thus, the hypothesis could not be rejected that average profitability over time was independent of the degree of product diversification for food processing firms. Because of the tests employed and the limitations of the data, we can only say that diversified firms tend to be no more profitable over time than nondiversified firms. We cannot conclude from these tests that diversified firms are no more profitable than they would have been had they not become diversified. Nor can we test this conclusion with available data. We are unable to pinpoint the time period during which firms made significant changes in their product mix. And we are unable to pinpoint the existence of multiple changes in the product mix over time.

Average profits of the firms in each group were calculated for each year between 1947 and 1965. Trend lines were then calculated for each group to investigate further the profit characteristics of diversified and nondiversified firms.

The trend lines are as follows:

Group I	$Y = .081 - .003\,X$
Group II	$Y = .094 - .003\,X$
Group III	$Y = .110 - .002\,X$
Group IV	$Y = .103 - .002\,X$

They indicate little difference in the intercept of the four groups. However, the diversified firms had a slightly slower rate of decline in profits than did the nondiversified firms. The negative slope is caused by selection of the high profit postwar years for the initial years in the period.

The second hypothesis tested was that the highly diversified firms grew more rapidly (in terms of total assets) than the lesser or nondiversified firms. Again, a 4 X 3 chi-square contingency table was used as a test, and the four rows of the table represented the four levels of diversification (groups of firms). The columns represented three growth rates from 1947 to 1965: Firms that grew by less than 1.3 percent per year; firms that grew from 1.4 to 7.3 percent per year; and firms that grew by more than 7.3 percent per year. A chi-square coefficient of 6.82 did not allow rejection of the hypothesis that growth is independent of the groupings of firms according to diversification. The figure 6.82 suggests merely that diversified growth is a substitute for horizontal growth. Again, the weakness of the test does not allow us to conclude that firms that diversified would have grown as rapidly had they not diversified.

The third hypothesis tested with time series data was that diversification is used to avert risk and thus reduce the profit instability of firms. Again, data were not available to construct a direct test. Average variances of the firms in each of the four groups were calculated. Bartlett's test for homogeneous variances was then used to determine whether average variances of firms in the four groups differed significantly. Results from Bartlett's test led to rejection of the hypothesis that variances of the four groups are equal ($X^2 = 13.778 > X^2_{(.99)(3)} = 11.300$).

It was then necessary to construct tests to determine the significance of the differences in variances and the ranking of these differences. The most significant differences were between groups I and IV. The hypothesis was rejected that $\sigma_{I}2$ is less than or equal to σ_{IV}^2 (.995 level of significance). From the previous test, variances of these groups were found to be unequal, leaving only the result that $_{IV}^2$ was less than $_{I}^2$. Similarly, $\sigma_1^1 > \sigma_3^2 > \sigma_2^2 > \sigma_4^2$. Thus, the average variance in the profitability of firms is lower for the diversified group than for the nondiversified group. This finding supports the Markowitz contention that diversification, even though it may occur in cyclically unstable industries, has a stabilizing effect on profit rates of firms.

These results will now be fitted into findings of other studies before we examine results of tests of the study model with average gross margin as the dependent variable. We do this because these results of other studies relate more specifically to the importance of specific variables in the model than to the complete model.

In a study of the entire manufacturing sector, Fuchs stated that "rates of return on corporate assets are not very closely related to the concentration ratio . . ." even though he used industry averages that eliminated all within industry variation of profit rates (13, p. 291). The rate of return on corporate assets was highly correlated to the return on invested capital for the firms in the present study. Thus, Fuch's results are consistent with those of the present study. Bain concluded from his 1936-40 data that the regression line showed a downward slope for profit as concentration decreased, " . . . but the correlation is poor and the fit to any such line is obviously so poor that the inference of a rectilinear or other simple relationship of concentration to profits is not warranted" (4, p. 313). Industries examined by Bain exhibited a significantly higher average level of profits when 8-firm concentration ratios were above 70 percent. However, these industries also exhibited a significant increase in average profitability when 8-firm concentration ratios were below 30 percent. Economic theory explains the relationship existing when the ratios are above 70 percent. There is no apparent economic theory to explain the relationship at the other extreme.

Using cross-sectional comparisons, Levinson found that the correlation between concentration and profitability ranged from 0.071 to 0.755. His finding indicated that no stable relationship existed between the two factors from 1947 to 1958 (20).

Evidence from these studies, accompanied with the present findings, supports the conclusion that little relationship exists between profitability and concentration in the food manufacturing industries. If the large multiproduct food corporations possess monopoly power, such power is not evident in performance measured by the ratio of profit to net worth. There is equally as much variability of profit for firms within a given level of primary industry concentration, size of firm, and levels of diversification as there is between the various levels of these factors. In addition, no relationship was found between average profitability and the average level of each of these above three factors, after groupings had been made to eliminate within industry and within group variation.[38]

Two recent studies, again relating to the total manufacturing sector, were based on the firm as the unit of observation, as in the present study, rather than the industry, as in Bain's and Levinson's studies. Weiss and Hall, with a sample of approximately 400 of the largest manufacturing firms, found a statistically significant relationship between weighted concentration (X_2), size of firm, and profitability. Size of firm was a much more significant explanatory variable of profitability than weighted concentration (41).

Testing an entirely different hypothesis, Kamerschen had similar findings (17). He found no significant relationship between profitability and concentration in either simple or multivariate analysis. But he found size of firm to be related significantly to profitability (17, pp. 445-446).

Kamerschen was forced to use subsamples for the same reasons that they were used in this study. The absolute level, as well as the level of statistical significance of the coefficient on the size of firm variable, was somewhat sensitive to the subsampling in both studies. This finding might possibly be due to the importance of a few key observations about large firms. The qualifying "might" is used because the inclusion of only relatively large corporations in both studies makes the possibility unlikely.

The partial correlation coefficients for the variables in equation 3' indicated that size of firm (X_3) explained more of the variation in profitability than did concentration (X_1). However, this result is of little importance since both the coefficients on the variables were not statistically significant. Using the same equation, the variable, minimum optimal-size plant (X_6) explained more of the relationship. More correctly, the variable was more closely related to differential levels of profitability than either of the previously mentioned variables. This conclusion was unexpected. Barriers to entry created by size of plant are usually considered minimal in food processing industries relative to other industries. The only apparent explanation lies in the word "relative." Other industries (nonfood) are not in this study. Thus, the variable, minimum efficient-size plant becomes important relative to the various levels of this variable for different food processing industries.

[38] Stigler's extensive study of capital and rates of return in manufacturing indicated no relationship between industry concentration and profitability (31, pp. 66-71).

The sign of the capital-output ratio was consistent with the findings of Collins and Preston (6, p. 236). Since the variable was included as an adjustment factor to account for differences in the levels of capital intensities, no conclusions need be drawn from the coefficients on the capital-output variable.

AVERAGE GROSS MARGIN AS A MEASURE OF PERFORMANCE

The results from the estimation of equations 2 and 3 were somewhat different when average gross margin was used as a dependent variable in place of the ratio of net profit to net worth. People have suggested that the ratio of net profit to net worth understates true profits for the following reasons: Executives receive high compensation; advertising may be profit determined or at least partially considered as a quasi-monopoly profit, or both possibilities may be true; and depreciation may serve as a source of liquidity rather than as a real cost item in the decision models of the firm (6, 15, 41).

Average gross margin was calculated as total revenue minus cost-of-goods sold divided by total revenue. Of any available accounting measures, cost-of-goods sold most nearly approximated the direct (or variable) costs of production, including direct labor costs. The numerator was composed of net profit plus depreciation and amortization; general administrative expenses (including executive compensation); advertising expenses; and interest payments to total revenue. These items are included in the numerator for either of the following two reasons. Their measurement is such that the account bears little relation to the underlying economic basis for their existence. Therefore, they are not completely true-cost items to be evaluated in a fashion similar to the cost-of-goods sold items when making a pricing decision. Or they are particularly susceptible to including quasi-profit payments. The remaining ratio is then a measure of the firm's ability to price above direct cost of production.

The simple correlation coefficients of structural measures with average gross margin are given in table 6. The table shows that the strength of correlations between the structural variables and average gross margin increases more than the correlation between the same structural variables and the ratio, net profit to net worth. The linear relationship between concentration in a firm's primary industry and average gross margin explains more of the variability in the average gross margin variable than does a linear relation between the concentration variable and the ratio, net profit to net worth. The relationship between size of firm and average gross margin is significant at the 99-percent level. A similar level of significance was displayed in the relationships between the level of diversification; that is, between the ratio of nonprimary sales to total manufacturing sales and average gross margin. Nonsignificant relations (at the 95-percent level) were found between average gross margin and the following: (1) diversified concentration index; that is, $\Sigma a_i c_i$—the measure used in the NCFM study; (2) the composite measure of the level of diversification; that is (nonprimary sales)d/total sales[39] where d is the number of four-digit industries in which the firm operates; and (3) the minimum efficient-size plant. The remaining correlations were positive and significant at the 95-percent level.[40] The estimation of equation 2 with the data described above, for 134 firms classified in food processing industries, yielded the following result:

$$\text{Equation 10—}\hat{Y} = 0.143 + \underset{(2.36)}{0.150X_1} + \underset{(2.88)}{0.000002X_3}$$

[39]The author sees no apparent explanation for the fact that significant correlation was found between average gross margin and the ratio of nonprimary sales to total sales and not between average gross margin and d multiplied by the ratio of nonprimary sales to total sales. A possible explanation is that d or the weighting systems of one for each four-digit industry into which the firm is diversified are inadequate representations of the true weights of different products. The concept of "node commonality" suggests that the products should not all be given the same weight (22).

[40]The results of the multiple correlation analysis will be presented before discussing implications of these correlations.

Table 6.—Simple correlation coefficients of structural measures with average gross margin, 104 food processing firms, 1964/65

Structural variables	X_1	X_3	a_ic_i X_2	Non-primary sales / total sales D_1	Non-primary sales(d) / total sales D_2	Minimum efficient-size plant X_4	Net profit / net worth Y_1[1]	Average gross margin Y_2[2]
X_1	1	-0.082	0.740	0.027	-0.063	0.457	0.066	0.149
X_3		1	0.126	0.628	0.721	-0.135	0.091	0.260
X_2			1	0.015	0.048	0.346	0.062	0.081
D_1				1	0.745	-0.064	0.084	0.263
D_2					1	-0.090	0.051	0.123
X_4						1	0.102	0.047
Y_1							1	0.153
Y_2								1

[1] Y_1 = net profit/net worth.
[2] Y_2 = average gross margin.
The relationship between size of firm and average gross margin is statistically significant at the 95-percent level when r is greater than .16.

The t values given in parentheses show that both regression coefficients are statistically greater than zero at the 95-percent confidence level. The level of explained variation, R^2, was 9 percent; thus, the fit must be considered weak.[41]

These correlation and regression results show that a positive relationship exists between the structural variables and average gross margin that did not exist between the same variables and the ratio, net profit to net worth. We can draw certain economic implications by comparing the simple correlation coefficients with the multiple correlation results of the sets of equations, using different dependent variables. These implications are discussed after test results are explained. Equation 3 was tested in two ways: first with X_2, X_3, X_4, and X_7, referred to as 3a; and second with X_1, X_2, X_3, X_4, and X_7, referred to as 3b. The estimated values for equations 3a and 3b were the following:

$$\text{Equation 3a—}Y = \underset{}{.140} - \underset{(-.330)}{.029X_2} + \underset{(2.380)}{.0000016X_3} + \underset{(.096)}{.149X_4} + \underset{(3.146)}{.386X_7} \qquad R^2 = .16$$

$$\text{Equation 3b}-Y = .101 + \underset{(.959)}{.074X_1} + \underset{(1.71)}{.003X_2'} + \underset{(.805)}{0000006X_3} - \underset{(-.570)}{.914X_4} + \underset{(3.244)}{.392X_7} \qquad R^2 = .20$$

Equation 3b was unacceptable because the high degree of multicollinearity between X_2' and X_3 (in excess of .6) caused erratic changes in the coefficient. Evidence of this change is drawn from the simple correlation analysis.[42]

The equations show that size of firm is of utmost importance in determining average gross margin when the model is adjusted for differences in capital intensity. Primary industry concentration, as well as the weighted concentration measures, (X_2 and X_2) are of questionable importance, due to the statistical problems caused by multicollinearity. The largest firms (not necessarily those in the most concentrated industries) have the highest average gross margins. This fact raises two possible explanations for the high margins held by the large companies.

The first explanation is that high margins could be the result of real or pecuniary economies in production of goods. If this is true, a negative relation should exist between average cost-of-goods sold and size of firm. The simple correlation between cost-of-goods sold and size of firm is -0.05, which causes one to reject the hypothesis that a linear relationship exists between the two variables. Thus, the hypothesis that the coefficient is less than zero and that real or pecuniary economies are of major concern was rejected.[43]

The second possible explanation is that large firms achieve higher margins by selling their products at higher prices. Since production costs were shown to be no lower for large firms, this fact increases the probability that higher margins may result from higher prices. This explanation raises the question: How can firms selling the same product in the same markets charge different prices? First, large firms may not be selling in the same market with small firms. However, most retail stores carry both private or local brands and national brands. Thus, direct competition exists in most cases. Second, large firms with high margins also had high advertising costs.[44] "Coupon offers" and "price-off" offers are examples of both advertising and price competition. Other forms of advertising differentiate the advertised from the nonadvertised product in the minds of consumers. Thus, a firm can charge a higher price for a differentiated product. Large advertising expenditures increase the level of overhead costs; this increase, in turn, brings down the rate of net profitability for large firms to the rate for smaller companies.

[41] The addition of the capital output ratio (X_7) increased the level of explained variation, R^2, to 17 percent. The estimated equation was as follows:

$$\text{Equation 11} - \hat{Y} = .097 + \underset{(1.89)}{.115\,X_1} + \underset{(2.66)}{.000002\,X_3} + \underset{(3.36)}{.35\,X_7}$$

[42] The change in the sign of variable X_4 in 3b can be disregarded because of the lack of statistical confidence in either estimate.

[43] This is not a test of the hypothesis that larger firms might have real or pecuniary economies owing to their size. Many activities of the firm that could have influenced scale effects at the company (not plant) level were removed from the ratio used to test the hypothesis.

[44] Advertising is mentioned specifically because it is the only component of the numerator of the ratio (average gross margin) for which data permitted direct measurement. These data are discussed in Appendix A.

Besides being large advertisers, the large firms in food processing are virtually the only firms that have large research and development budgets. Markham and McFarland point out that firms in the largest size-class of food processing firms (5,000 or more employees) have less than one-third of total food processing sales, but account for approximately 80 percent of R. & D. expenditures made by food processing firms (40, pp. 91-101). The largest firms spent three-tenths of one percent of each sales dollar on R. & D., compared with two-tenths for the middle-sized group (1,000-4,999 employees), and three-hundredths for the smallest firms. Thus, the largest food firms spent ten times as much on R. & D. as the smallest firms, in terms of expenditures as a percent of sales. Markham and McFarland further state that 75 food processors listed in Fortune's 500 Largest Corporations accounted for "as much as 90 percent of the total" R. & D. expenditures of food firms (21, p. 98).

A correlation between R. & D. expenditures and degree of conglomerateness, measured for these 75 firms by the number of four-digit industries in which they operated, indicated the existence of a significant positive relation between the variables. Thus, as the degree of conglomerateness (called diversification in this study) increased, the level of R. & D. expenditures as a percent of sales increased significantly (21).

These results, accompanied by the findings of the current study indicate that larger firms might be able to charge higher prices and extract a higher margin, not only because of advertising and promotion but also because of quality and innovative competition that is the expected result of research and development programs.

These results and findings support the position that two forms of competition exist among food processing firms. Smaller firms compete effectively by using price, whereas larger firms compete by using nonprice tools mentioned above, such as product differentiation and results of R. & D. outlays.[45]

IMPLICATIONS FOR FUTURE RESEARCH

This study represents an initial effort to determine the relationships between diversification, profitability, and other structural variables in large food processing firms. The study is limited in scope and leaves many questions either unanswered or untouched. Thus, to establish policy criteria based on the author's findings would be premature. As an attempt to explain some basic relationships, this research may lead us into a deeper understanding of the effects on our markets of the ever-increasing number and size of large, diversified corporations.

Among the important questions left unanswered by this study are the following:

(1) To what extent does diversification affect an individual firm's profits over time?

(2) To what extent is the market power of firms increased when they diversify?

(3) To what extent is the market conduct of firms altered by diversification; that is, do they use cross-product subsidization, reciprocal agreements, and so on, more than single-product producers do?

(4) Are definite gains in efficiency achieved through multiproduct operations?

(5) Are the large, diversified firms more progressive than single-product firms?

[45] Findings relating to the average gross margin variable must be qualified by the unknown but possible influence that vertical integration might have on the variable.

These represent only a sample of the questions that need to be answered if we are to have an intelligent public policy toward product diversification (much of which takes place by external expansion) that will be of benefit to the Nation.

APPENDIX A: RESULTS OF THE COMPLETE MODEL WITH LIMITED OBSERVATIONS

The complete set of data necessary for testing equation 1 were available for 44 firms. The results of the regression estimates of this equation are relevant to the general task of explaining the relationship between structural measures and profitability The results are being presented only in an appendix because the sample of 44 firms is substantially different in several respects from the sample of 134 firms (from which the 44 firms were drawn).

The extent of the differences between the two samples is shown in table 7.

Table 7.—Comparison of two samples of food processing firms, 1964/65

Selected variables	Sample 1 (44 observa- tions)	Sample 2 (134 obser- vations)
Average size of firm (assets) - X_3	$170,128,000	$109,945,000
Average 4-firm concentration ratio for primary industries - X_1	.36	.35
Average diversified concentration ratio (power) - X_2	.31	.26
Average level of diversification - D_1	.25	.16
Average profit to net worth ratio	.09	.05
Capital to output ratio	---	---
Average gross margin	.22	.22

Clearly, the average firm in the restricted sample was larger, more diversified, and less profitable than the average firm in the overall sample. The primary industry for the average firm in the smaller sample was no more concentrated than the primary industry in the larger sample.

With these differences in mind, we can report results of testing two forms of equation 1. In the first form, primary industry concentration (X_1) and weighted concentration of nonprimary activities, (X_2) were included to measure the structural concept of concentration. The resulting estimate was:

$$\text{Equation 11}-Y_1 = \underset{(.923)}{.132 + .143X_1} + \underset{(.595)}{.0026X_2} + \underset{(.197)}{.0000005X_3}$$
$$+ \underset{(1.97)}{9.300X_4} + \underset{(.706)}{.00057X_5} + \underset{(.183)}{.3047X_6} - \underset{(-2.92)}{1.242X_7}$$

The t values are given in parentheses.

In the second form, variable X_2 equal to $\Sigma a_i c_i$ was used as a weighted measure of concentration. The resulting equation was:

$$\text{Equation 12}-\hat{Y}_1 = .141 + \underset{(.886)}{.159X_2} + \underset{(.605)}{.0000012X_3}$$

$$+ \underset{(1.698)}{8.559X_4} + \underset{(.355)}{.0003X_5} + \underset{(.608)}{.847X_6} - \underset{(-3.120)}{1.231X_7}$$

The regressions can be discussed simultaneously because of the similar results. Both equations explained 29.30 percent of the difference in profit rates, using the selected structural variables. Both R^2's are statistically significant at the 90-percent level.

Although 29.30 is a low percentage of explained variation, this level is not insignificant when one considers the magnitude of the assigned task of the equation; that is, to explain differences in profit rates among heterogeneous economic units.

It is disappointing that the significance of the equation ends here. The t values indicate that the minimum optimum–size plant is the only variable other than the capital–output adjustment variable that has a value statistically significantly different from zero in either equation. The linear relation must be considered a poor representation of the true relationship between these variables.

The explanation that the significant coefficient on the minimum optimal size-of-plant variable measures one element of barriers to entry must be a tenuous one. Bain (4) and others studying barriers to entry found them lacking, for the most part, in food processing industries. These studies involved a larger universe of industries; for example, comparisons of barriers to entry in the auto industry with those in the food industries. In this type of comparison, the food industries would have very low barriers. However, comparisons involving only the different industries within the food processing universe present a different picture. The minimum efficient-sized plant in the animal slaughtering industry employed from one to nine employees. Such a plant in the meat processing industry employed 100-250 employees. This plant in the canned specialties industry employed 250-500 employees. Thus, substantial differences in industries' capital requirements exist, and are reflected in the differences in numbers of employees for minimum efficient-sized plants within food processing.

Table 8 of simple correlation coefficients, r, gives some indication of why the estimated equations look as they do. Although some useful information can be derived from simple correlation coefficients, most econometricians agree that more reliable information is shown in a multiple regression estimate. These coefficients indicate that no linear relationship exists between any of the explanatory variables taken individually and the ratio of net profit to net worth.

When the variable (D_1), describing the level of diversification, was added to table 8, there was a nonsignificant relationship between X_1 and D_1, (with a negative sign); X_2 and D_1; and X_6 and D_1. There were highly significant r values for X_3 and D_1; X_5 and D_1; and X'_2 and D_1.

As expected, these findings show a positive relationship between size of plant and level of diversification and absolute level of advertising[46]. Contrary to what might be expected, diversification is not correlated with either primary industry concentration (positively or negatively) or with the measure of weighted concentration.

Table 8.—Simple correlation coefficients, 44 food processing firms, 1964/65

Variable	X_1	X_2	X'_2	X_3	X_4	X_5	X_6	X_7	Y_1	Y_2
X_1	1.000	.476	-.062	-.185	.237	-.060	.332	.400	-.015	.131
X_2		1.000	.090	.194	.335	.310	.237	.231	.196	.027
X'_2			1.000	.611	-.173	.395	.406	-.020	.190	.158
X_3				1.000	-.172	.782	.137	.003	.187	.092
X_4					1.000	-.169	-.171	.379	.088	-.191
X_5						1.000	.243	.038	.189	.272
X_6							1.000	.451	-.126	.455
X_7								1.000	-.364	.353
Y_1									1.000	-.125
Y_2										1.000

Note: r^2 is significant at the 95-percent level if it is greater than .304 and at the 99-percent level if it is greater than .393.

One last point of interest appears in these results. There is no correlation between absolute level of advertising and primary industry concentration, but a significant correlation (at the 95-percent level) between primary industry concentration and rate of advertising expenditures. The existing correlation is not explained by the fact that these firms (in the more concentrated industries) are the largest firms in the sample, because the correlation between rate of advertising expenditures and size of firms is very low. The existing correlation could suggest that advertising is a barrier to entry. If this is the case, we should probably find a significant relationship between absolute level of advertising and primary concentration. We must leave this as an interesting query because we lack data and have advertising data too weak to allow pushing the argument further.

[46]The relationship between X_2 and D_1 is contrived by the definition of X_2. This relationship would be zero if D_1 were zero.

In the pattern used earlier and for the same reasons, the same two forms of equation 1 were again estimated, this time using average gross margin as the dependent variable. The estimated equations were:

$$\text{Equation 13—}\hat{Y}_2 = \underset{}{.128} - \underset{(-.338)}{.033X_1} + \underset{(.698)}{.002X_2} - \underset{(-1.518)}{.0000024X_3} - \underset{(-1.735)}{5.076X_4}$$

$$+\underset{(1.925)}{.0001X_5} + \underset{(.628)}{.646X_6} + \underset{(2.195)}{.575X_7}$$

R^2 was .36.

$$\text{Equation 14—}\hat{Y}_2 = .145 - \underset{(-.716)}{.078X_2} - \underset{(-1.40)}{.000002X_3} - \underset{(-1.30)}{4.029X_4}$$

$$+ \underset{(1.92)}{.009X_5} + \underset{(1.28)}{1.101X_6} + \underset{(2.03)}{.490X_7}$$

R^2 was .36. The t values are given in parentheses in both equations.

In these regressions, a more respectable share of the differences in average gross margin is explained by the structural measures even though the correlation is still low. Two features of the regression are worth noting. First, many of the variables have a negative sign rather than the expected positive sign and second, none of the coefficients can be considered significantly different from zero at the 90-percent level of confidence. This second feature could explain the negative signs of the variables. Size of firm and level of concentration both display a negative relationship to average gross margin. This is caused in part by the very weak, negative relationship between net profit rate (Y_1) and average gross margin (Y_2). This negative relationship again tends to support the idea that although average gross margin can be expanded with advertising, research and development, and so on, such expansion does not increase the net profit rate, but merely substitutes for the price forms of competition. This possibility was partially confirmed by the high, simple correlation between advertising rate and average gross margin shown in table 8.

Another possibly not independent explanation is that the low correlation is caused by the bias upward in average size of firm and many other variables in this sample. The largest firm may not have the largest average gross margin or may not be in the most concentrated industry. This firm may also not have the highest net profit rate (discussed earlier in the text). When the sample included only the largest group of firms in the study, the influence of this group was strong enough to outweigh other parts of the distribution and to make the sign of the variables negative.

Finally, the inconclusiveness of the results of this sample indicates the need for more investigation of both the theory leading to the often accepted hypotheses and the data used or needed to test these and new hypotheses.

APPENDIX B: DISTRIBUTIONS OF VARIOUS DATA USED IN THE STUDY

Table 9.—Distribution of net profit/net worth ratios by size of firm, 134 firms, 1964/65

Asset size (millions)	Firms having net profit/net worth ratios of –						
	Less than zero	0-.05	.051-.10	.101-.15	.151-.20	.201-.25	.251 or above
$ 0-9.9	8	6	7	11	4	0	1
10-24.9	1	3	9	5	6	1	2
25-49.9		1	5	4	4		
50-99.9	3		10	3	2		
100-249.9		1	6	7	2	2	
250-499.9			3	8	2		
500 or above		1	1	2	2	1	

Table 10.—Distribution of diversified power index by size of firm, 104 food processing firms, 1964/65

Asset size (millions)	Index number of diversified power								
	0-.10	.11-.20	.21-.30	.31-.40	.41-.50	.51-.60	.61-.70	.71-.80	.81 or above
$ 0-9.9		7	10	4		1	2		
10-24.9		5	4	4	1			1	
25-49.9		3	3	5				1	
50-99.9		5	5	3	1	2	2		
100-249.9		2	8	2	1	2	1		
250-499.9		2	4	2	3			1	
500 or above		1	3	1		1	1		

Table 11.—Distribution of primary industry concentration by size of firm, 104 food processing firms, 1964/65

Asset size (millions)	Primary industry 4-firm concentration ratios									
	.0-.10	.11-.20	.21 .30	.31-.40	.41-.50	.51-.60	.61-.70	.71-.80	.81-.90	.91-1.00
0-9.9		5	11	3	1	3	2			
10-24.9		3	4	5	1			1		
25-49.9			2	7	1	2		1		
50-99.9			6	4	2	2	2	1		
100-249.9		1	3	6	2	2	1		3	
250-499.9		1	5	3			1			
500 and above		3	2	2						

Table 12.—Distribution of the extent of product diversification by size of firm, 104 food processing firms, 1964/65

Asset size (millions)	Nonprimary sales/total sales (D)								
	0	.01-.10	.11-.20	.21-.30	.31-.40	.41-.50	.51-.60	.61-.70	Over .70
$ 0-9.9	24	1			1	1			
10-24.9	10	2			1				
25-49.9	3	2		1	2	2	1		
50-99.9	4	3	6	1	2	2	1		
100-249.9	1		4	3	2	1	2	1	2
250.499.9		1	2		2	1	4		2
500 or above					2	1	1	1	2

Table 13.—Diversification data by company code

Company code	D_1	D_2	$\Sigma a_i c_i$	Company code	D_1	D_2	$\Sigma a_i c_i$
306	.443	.886	.314	901	0	0	.620
308	.711	3.555	.482	902	.456	2.737	.344
310	.047	.190	.188	903	.178	.356	.356
311	.548	2.194	.339	906	.433	4.325	.582
312	.767	5.366	.395	908	.611	7.326	.372
313	0	0	.240	909	0	0	.370
316	.314	1.571	.189	910	0	0	.360
317	0	0	.240	911	.197	.589	.691
318	0	0	.240	912	.819	9.009	.282
319	.117	.234	.231	913	0	0	.200
321	0	0	.250	2001	0	0	.670
322	0	0	.370	2002	.068	.203	.279
323	0	0	.250	2003	.517	3.101	.564
324	0	0	.240	2004	.592	2.367	.216
325	0	0	.620	2006	0	0	.110
326	.245	1.471	.207	2007	.0599	.119	.563
328	0	0	.370	2010	.357	2.143	.178
329	0	0	.240	305	.361	1.083	.157
401	.515	2.059	.210	109	.217	.651	.283
402	0	0	.730	108	0	0	.330
405	.057	.1146	.286	111	.110	.330	.306
406	0	0	.400	112	.021	.041	.324
407	.585	3.508	.136	113	0	0	.140
408	0	0	.220	114	.039	.079	.319
410	.524	4.718	.438	115	.088	.176	.299
412	0	0	.710	116	0	0	.330
413	.142	.425	.281	118	.317	5.064	.287
414	0	0	.800	119	.477	.954	.207
418	0	0	.220	120	0	0	.130
419	.370	4.074	.420	121	0	0	.110
421	.158	.792	.637	122	.161	2.099	.288
422	.235	.705	.228	202	.268	4.290	.178
423	.376	3.004	.298	203	.636	17.819	.246
424	.593	5.335	.507	204	.515	4.633	.277
425	.433	3.030	.198	206	.437	1.747	.192
426	0	0	.360	207	0	0	.190
427	0	0	.440	209	.502	3.011	.218
428	0	0	.350	210	.242	.968	.223
501	.002	.005	.201	213	.368	1.104	.201
502	.223	.668	.201	215	0	0	.190
503	.072	.144	.200	216	.738	11.068	.268
504	0	0	.590	218	.691	5.528	.211
505	0	0	.200	301	0	0	.240
507	0	0	.200	302	.114	.342	.218
508	.050	.100	.452	303	.189	.943	.424
511	0	0	.230	107	.289	1.736	.262
513	.148	.443	.260	106	0	0	.330
514	0	0	.230	105	0	0	.130
515	.583	3.501	.332	103	.056	.167	.327
516	0	0	.200	102	.376	4.888	.198
517	0	0	.200	101	.301	.603	.110
518	.053	.157	.250				

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